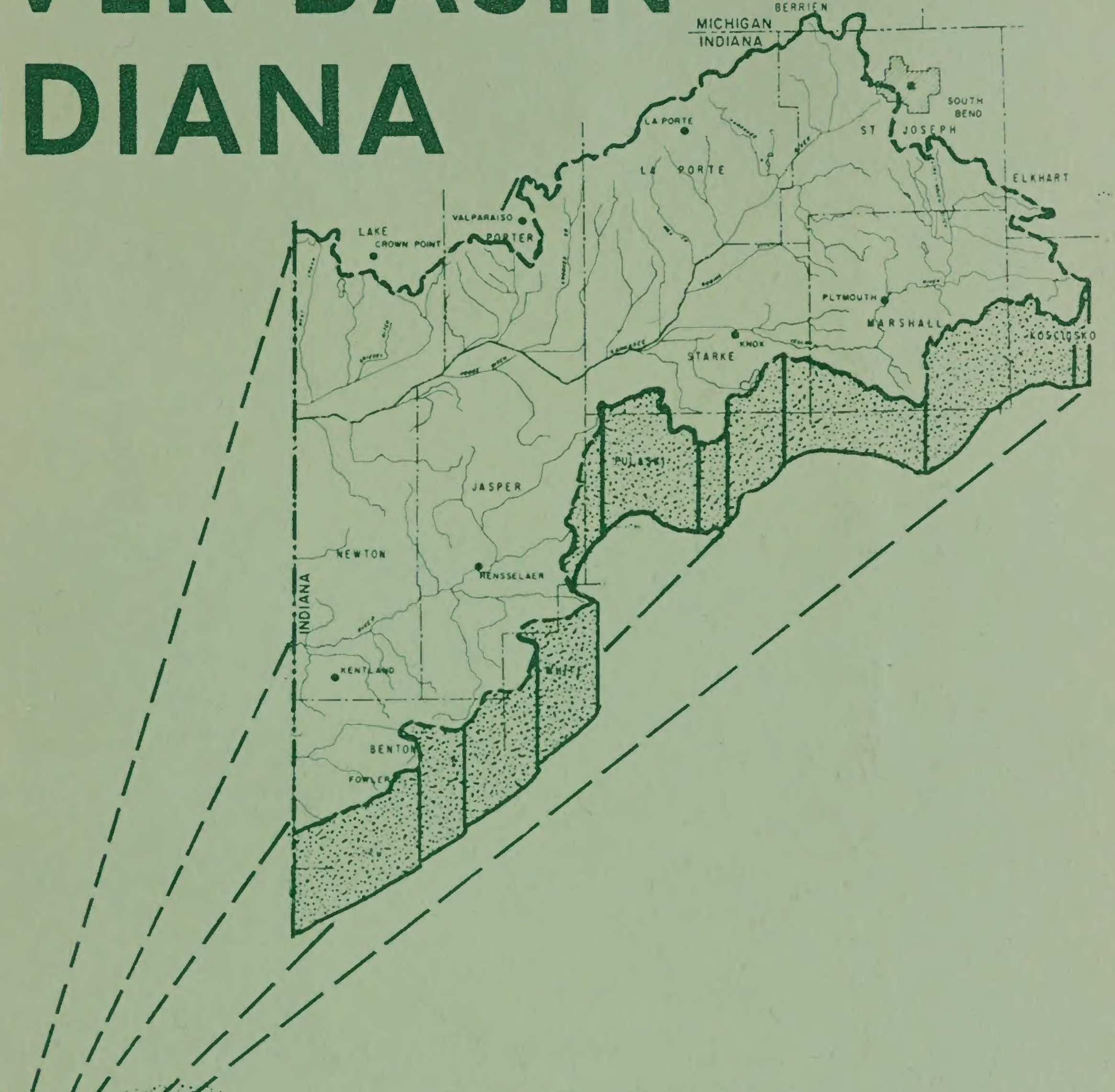
KANKAKEE RIVER BASIN INDIANA



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Department of Natural Resources
State Planning Services Agency
State Board of Health

U.S. Department of Agriculture
Soil Conservation Service
Forest Service
Economic Research Service

U.S. Department of Interior
Geological Survey

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REPORT ON
THE WATER AND RELATED LAND RESOURCES

KANKAKEE RIVER BASIN

INDIANA

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PREFACE

The Kankakee River Basin Study was requested by the Indiana Department of Natural Resources in December 1968 after having received letters of support for such a study. These letters were from local officials in the counties involved. In June 1969, the Soil Conservation Service requested authority for the U.S. Department of Agriculture to participate in the study. The request was supported by U.S. Congressmen representing the area. In July 1970, USDA received authorization to share responsibility of the study with the State of Indiana.

The nature and scope of this study dictated that study activities be pursued consistent with policy and procedures of participating federal, state and local agencies. To assure compatibility with objectives of citizens within the Basin, the Citizens' Advisory Group, representing local individuals, organizations and units of government was organized as part of the study structure. The Citizens' Advisory Group participated in nine (9) public meetings within the Basin. These meetings provided opportunities for the citizens to express opinions or ideas and provide information about resource problems and needs. These public meetings were sponsored by the Coordinating Committee which consists of the heads of participating state and federal agencies.

In addition to the public meetings, representatives of participating federal agencies exchanged information and coordinated their work among themselves and with appropriate state agencies. This process resulted in the formulation of alternatives to meet identified needs.

Periodic meetings of task forces which consisted of representatives of the federal and state agencies and the Citizens' Advisory Group, were held to assemble and exchange pertinent data and to review progress of the study. These meetings were held throughout the study in an effort to insure that consideration would be given to views of the state and local units of government as well as individual citizens and organizations.

Comments and suggestions received from federal, state and local agencies and from individuals and organizations in regard to the Final Draft Report of July 1976 have been considered. Appropriate changes have been incorporated in this report which identifies the water and related land resources within the region and the problems or needs associated with those resources. The actions listed in the "Suggested Plan" should be considered opportunities for development. This report does not lead directly to implementation. It does provide a framework of compatible actions which can be implemented as programs and/or resources become available and local support is evident. The identified actions will become a reality only with local leadership and local decisions that the Basin's resources should be utilized for the betterment of the human and natural environment.

ABSTRACT

The Kankakee River Basin Study was authorized in July 1970 for cooperative federal-state technical assistance to the Basin residents because of a keen interest of local and state authorities in consolidating planning efforts to analyze the water and land related resources of the area. The study provides physical and economic information about the Basin including problems and needs, identification of alternative projects and programs to meet those needs, evaluation of alternatives, and the application of multiple-objective planning within the limitations of the data available.

To assure compatibility with objectives of citizens within the Basin, the Citizens' Advisory Group, representing local individuals, organizations and units of government, was organized as part of the study structure. The Citizens' Advisory Group participated in nine public meetings within the Basin. These meetings provided opportunities for the citizens to express opinions or ideas and provide information about resource problems and needs.

This report is not intended to be an all-encompassing problem-solving effort. Rather, to the extent that data are available, alternative actions are provided to help meet major problems which require cooperative effort among local, state, and/or federal agencies and the Basin residents. The alternatives show ways in which requirements for water and land-related goods and services can be provided, as well as meeting specific demands for satisfying environmental quality considerations.

The problems and needs as identified are:

1. Proper use and management of land for sustained agricultural production is a basic need in the conservation, development, and utilization of land and water resources. Some land use changes should be considered, primarily a conversion to permanent cover of grass and trees on steep to rolling cropland.

2. Flooding occurs along most of the Kankakee River main channel and its tributaries affecting about 222,000 acres, including 180,000 acres of cropland.

3. Soil erosion is a problem in isolated areas. Sediment problems in the Basin do not appear to be as severe as adjoining areas which have higher suspended load discharge in the streams.

4. The installation of adequate drainage systems is needed on about 439,000 acres of existing cropland.

5. There are needs for increased recreation opportunities in the Basin, particularly those activities which are considered land-based.

6. The Basin is rich in natural water areas and prime wetlands. There is a need to protect and maintain the wildlife and fish habitat on much of these areas.

In accordance with the Water Resources Council's "Principles and Standards for Planning Water and Related Land Resources" two alternatives were developed to satisfy problems and needs identified with the National Economic Development and Environmental Quality objectives. Elements (some at different levels of development) from these two alternatives were combined to form three additional alternatives which include specific actions to help meet both objectives.

The following combination of plan elements was formulated as a "Suggested Plan":

1. Channel work for flood control and drainage on 259 miles of 13 selected tributary streams and 26 miles of the upper Kankakee River Main Stem with levees along 49 miles of the Kankakee River from U.S. Route 30 downstream to U.S. Route 41.

2. Amend or adopt flood plain zoning ordinances, building codes, and similar regulations for all identified flood prone areas in the Basin and permit eligibility for flood insurance.

3. Accelerate land treatment program by installing conservation measures to adequately treat about 426,400 acres of cropland, grassland and forest land.

4. Accelerate land treatment program by installation of on-farm drainage systems to adequately treat 247,500 acres of existing cropland.

5. Develop about 2,700 acres of county parks and 1,500 acres of regional parks near or adjacent to water areas to satisfy a variety of recreational needs.

6. Develop a riverside recreational area on about 450 acres along the Kankakee River in Lake County.

7. Provide public access for canoeing on 112 miles of the Kankakee, Yellow and Iroquois rivers.

8. Develop about 20 miles of bridle trails along the Iroquois River.

9. Establish about 37 miles of trails for bicycling, hiking and nature walks along the Kankakee River, between the river and natural areas, and from the river or natural areas to urban centers.

10. Implement land use changes on 12,650 acres to bring the use of the land within its sustained agricultural capabilities.

11. Establish program to protect the natural, aesthetic, and wildlife values of about 5,000 acres of classified wetlands.

12. Establish program to protect about 100,000 acres of woodland in its natural habitat.

13. Establish program to protect, enhance, and maintain the wildlife and fisheries habitat along 254 miles of stream.

The total cost for installing the suggested plan is estimated to be approximately \$124,739,000. In terms of national economic development, the average annual benefits are estimated to be \$11,609,800 with an average annual cost (adverse effects) of \$8,168,200. The overall average annual net beneficial effects is \$3,441,600 .

The suggestions for development, if implemented, would provide about 3,520 man-years of temporary jobs for installation of plan elements, about seven permanent seasonal jobs in the recreation sector, and about 50 permanent jobs in the agricultural and operation and maintenance areas.

As a result of the suggested plan, about 230,000 acres of flood prone and wetland areas would be dedicated to agricultural, natural or recreational uses. Riparian wildlife and fishery habitat would be maintained on about 260 miles of stream. The application of conservation measures would be accelerated on about 426,000 acres of agricultural and forest land. Smaller land areas will have temporary or permanent land use changes. About 1,212,000 recreation visits are projected for the rural and urban population.

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CHAPTER I. SUMMARY

A. Objective and Scope of Study

The Kankakee River Basin Study was authorized for cooperative federal-state technical assistance to the Basin residents due to a keen interest of local and state authorities in consolidating planning efforts to analyze the water and land related resources of the area. The study provides physical and economic information about the Basin including problems and needs, identification of alternative projects and programs to meet those needs, evaluation of alternatives, and the application of multiple-objective planning within the limitations of the data available.

This report is not intended to be an all-encompassing problem-solving effort. Rather, to the extent that data are available, alternative actions are provided to help meet major problems which require cooperative effort among local, state, and/or federal agencies and the Basin residents. The alternatives show ways in which requirements for water and land-related goods and services can be provided, as well as meeting specific demands for satisfying environmental quality considerations.

B. Size and Location of the Basin

The Kankakee River Basin is located in northwestern Indiana and northeastern Illinois. This entire area encompasses 5,165 square miles of which 2,169 are in Illinois and 2,996 are in Indiana (see Plate 1). This study is directed primarily toward the Indiana portion of this area which includes portions of 13 counties in northwestern Indiana.

C. Problems and Needs

Proper use and management of land for sustained agricultural production is a basic need in the conservation, development, and utilization of land and water resources. Over 955,500 acres of agricultural land need adequate treatment with conservation practices. Some land use changes should be considered, primarily a conversion to permanent cover of grass and trees on steep to rolling cropland.

Flooding occurs along most of the Kankakee River main channel and its tributaries affecting about 222,000 acres, including 180,000 acres of cropland. About 86,060 acres of cropland are flooded on the Kankakee River main stem and 94,040 acres of cropland on the tributaries.

Soil erosion is relatively low; however, there are isolated areas where erosion is considered severe. Sediment problems in the Basin do not appear to be as severe as adjoining areas which have higher suspended load discharge in the streams.

The installation of adequate drainage systems is needed on about 439,350 acres of existing cropland. These areas are situated in small "land-locked" depressions; in low, wet muck areas; or in fields along streams.

There are identified needs for increased recreation opportunities in the Basin, particularly those activities which are considered land-based. Snow skiing is the only land based activity for which no additional need exists. Swimming and fishing are the only water-based activities for which no immediate needs exist.

The Basin is rich in natural water areas and prime wetlands. There is an identified need to protect and maintain the wildlife and fish habitat on many of these areas.

D. Findings and Conclusions

In accordance with "Principles and Standards for Planning Water and Related Land Resources" 1/ alternatives were developed to satisfy problems and needs identified with the National Economic Development (NED) and Environmental Quality (EQ) objectives. These are identified as Alternative A and Alternative E respectively, and are discussed in Chapter IX and Summarized in Tables IX-5 and IX-6. Elements (some at different levels of development) from those two alternatives were combined to form three additional alternatives (B, C, and D), which include specific actions to help meet both objectives. The elements (actions) contained in each of the five alternatives are discussed in Chapter IX and summarized in Tables IX-5 through IX-9.

Public response to the 5 alternatives failed to yield a consensus of opinion regarding a direction for development. However, it was determined that the study should present some combination of plan elements that would approach a viable solution to the problems in the Basin. Therefore, the following combination of plan elements was formulated as a "Suggested Plan":

1. Channel work for flood control and drainage on 240 miles of 13 selected tributary streams and 26 miles of the upper Kankakee River main stem with levees along the Kankakee River from U.S. Route 30 to U.S. Route 41.

2. Amend or adopt flood plain zoning ordinances, building codes, and similar regulations for all identified flood prone areas in the Basin and permit eligibility for flood insurance.

1/ Water Resources Council, "Principles and Standards for Planning Water and Related Land Resources", Federal Register Vol. 38, No. 174, Part III, Sept. 10, 1973, effective Oct. 25, 1973.

3. Accelerate land treatment program by installing conservation measures to adequately treat about 426,400 acres of cropland, grassland and forest land.

4. Accelerate land treatment program by installation of on-farm drainage systems to adequately treat 247,500 acres of existing cropland.

5. Develop about 2,700 acres of county parks and 1,500 acres of regional parks near or adjacent to water areas to satisfy a variety of recreational needs.

6. Develop a riverside recreational area on about 450 acres along the Kankakee River in Lake County.

7. Provide public access for canoeing on 112 miles of the Kankakee, Yellow and Iroquois Rivers.

8. Develop about 20 miles of bridle trails along the Iroquois River.

9. Establish about 37 miles of trails for bicycling, hiking and nature walks along the Kankakee River, between the river and natural areas, and from the river or natural areas to urban centers.

10. Implement land use changes on 12,650 acres to bring the use of the land within its capabilities.

11. Establish program to protect the natural, aesthetic, and wildlife values of about 5,000 acres of classified wetlands.

12. Establish program to protect and properly manage about 100,000 acres of woodland in its natural habitat.

13. Establish program to protect, enhance, and maintain the wildlife and fisheries habitat along 254 miles of stream.

The total estimated average annual beneficial monetary effects of elements satisfying the National Economic Development objective in the NED account of the Suggested Plan are about $11,610,000, while the total adverse monetary effects are about $7,382,000. The total average annual adverse monetary effects of elements satisfying the Environmental Quality objective in NED account are about $786,000.

When monetary effects are considered in the Regional Development account of the Suggested Plan, the total estimated average annual beneficial effects to the region (state and local) for the NED objective are about $20,134,000, while the total adverse effects are about $6,066,000. Total adverse effects to the region for the Environmental Quality objective are about $1,049,200. The net monetary effect on the nation for the NED objective is a negative $9,840,000, while the net effect for the EQ objective is a positive $263,000.

The recommended accelerated land treatment program has an estimated installation cost of about $14,123,600 including technical assistance from existing USDA programs.

The recommendations for development, if implemented, would provide about 3,520 man-years of temporary jobs for installation of plan elements, about 7 permanent seasonal jobs in the recreation sector, and about 50 permanent jobs in the agricultural and operation and maintenance areas.

Physical and social effects of the Suggested Plan are summarized in the Environmental Quality and Social Well-Being accounts in Table IX-11. About 230,000 acres of flood prone and wetland areas would be dedicated to agricultural, natural or recreational uses. Riparian wildlife and fishery habitat would be maintained on about 260 miles of stream. The application of conservation measures would be accelerated on about 426,000 acres of agricultural land. Smaller land areas will have temporary or permanent land use changes. About 1,212,000 recreation visits are projected for the rural and urban population.

In addition to the elements in the Suggested Plan, additional recommendations are included in Chapter IX which support the continuation of existing programs or initiation of action under existing authorities.

Table I-1 summarizes the status of PL-566 applications and the eleven selected potential projects. Of the eleven potential projects seven currently have applications for planning assistance. Table I-2 summarizes monetary, physical and social effects of the various categories of elements in the Suggested Plan, as well as relate the elements to program opportunities which may exist. Chapter X provides further discussion of opportunities for development as they relate to USDA, state and local programs, or to the need for program development or further inter-agency coordination.

TABLE I-1: STATUS OF SMALL WATERSHEDS (PL-566)

Kankakee River Basin, Indiana

Watershed	Counties	Application Number (IND)	Application Approved	Preliminary Investigation Completed	Authorized for Planning	Authorized for Operations	Remarks
Bailey Ditch	Starke	90	8-67	2-69	5-75		Planning underway 2/
Barnard (Hodge) Ditch	Jasper	14	10-58	3-63	-	-	Application cancelled 2/
Benkie Ditch	Porter	1/					2/
Breyfogel Ditch	Porter	1/					2/
Crooked Creek	Porter & LaPorte	1/					2/
Dehaan Ditch	Newton & Jasper						2/
Hanna Arm	LaPorte						2/
Upper Iroquois River	Jasper, White, Newton, Benton	11	9-57	4-60	8-60	-	Planning assistance terminated
Lower Iroquois River	Newton, Benton, Jasper, Ind; Iroquois, Ill.	10	9-57	4-60	8-60	-	Planning assistance terminated
Machler (Pitner) Ditch	LaPorte	116	1-72				To be serviced
Mill Creek	LaPorte	104	10-69				To be serviced
Phillips-Cornel Ditch	Porter	1/					2/
Porter County Kankakee	Porter, Lake and LaPorte	114	1-71				To be serviced
Robbins Ditch	Starke, St. Joseph, LaPorte & Marshall	111	11-70				To be serviced 2/
Sandy Hook Ditch	Porter	1/					2/
Singleton Ditch	Lake & Porter						2/
Upper Kankakee River	St. Joseph, LaPorte, Marshall & Starke, Ind; Berrien, Mich.	107	7-70				To be serviced
West Creek	Lake, Ind; Will & Kankakee, Ill.	7	4-56	11-56	11-56	12-59	Project terminated
Upper Yellow River	Marshall, St. Joseph, Kosciusko	109	9-70				To be serviced
Lower Yellow River	Starke & Marshall	108	9-70				To be serviced

1/ Part of Porter County Kankakee application (No. 114)
2/ River Basin Study indicated potential for development under PL-566

TABLE 1 - 2: SUMMARY OF SUGGESTED PLAN

Kankakee River Basin, Indiana

OPPORTUNITIES FOR DEVELOPMENT	NATIONAL ECONOMIC DEVELOPMENT: ANNUAL BENEFICIAL EFFECTS ($1,000)		NATIONAL ECONOMIC DEVELOPMENT: ANNUAL ADVERSE EFFECTS ($1,000)		ENVIRONMENTAL QUALITY: BENEFICIAL AND ADVERSE EFFECTS	REGIONAL DEVELOPMENT: ANNUAL BENEFICIAL EFFECTS ($1,000)	REGION	NATION	REGIONAL DEVELOPMENT: ANNUAL ADVERSE EFFECT ($1,000)	REGION	NATION	SOCIAL WELL-BEING: BENEFICIAL AND ADVERSE EFFECTS	PROGRAM OPPORTUNITIES: U S D A	PROGRAM OPPORTUNITIES: O T H E R
Channel Work Kankakee River - 26.0 mi. plus 49.0 mi. levees Bailey Ditch - 26.9 mi Barnard(Hodge)Ditch-37.8 mi. Benkie Ditch - 4.9 mi. Breyfogel Ditch - 6.7 mi. Crooked Creek - 13.5 mi. Dehaan Ditch - 10.5 mi. Hanna Arm - 20.6 mi. Phillips-Cornell Ditch -2.6mi. Robbins Ditch - 40.0 mi. Sandy Hook Ditch - 18.7 mi. Singleton Ditch - 56.4 mi. Cook Ditch - 12.2 mi.* Marquardt Ditch - 7.8 mi.*	Flood Prevention Drainage Net Beneficial Effect = 1,452.1	1,173.2 3,408.0 4,581.2	Installation Land Rights OM&R	1,469.2 1,396.4 263.5 3,129.1	1. Reduce bank erosion on 285 miles of stream 2. Disrupt aquatic and riparian ecosystem on 320 miles of stream. 3. Continued maintenance on 261 miles of riparian wildlife habitat. 4. Add 922 acres of permanent wildlife cover. 5. Provide permanent easement on 16,523 acres of wildlife habitat. 6. Destroy 680 acres of riparian wildlife habitat.	Income Flood Protection Drainage Wages and Salaries Indirect & Induced	1,173.2 4,715.5 640.1 1,141.4 7,670.2	-1,307.5 - 640.1 -1,141.4 -3,089.0	Installation Land Rights OM&R Net Beneficial Effect (Region) = 5,643.0 (Nation) = -4,190.9	367.3 1,396.4 263.5 2,027.2	1,101.9 1,101.9	1. Create 707 man-years low to medium income job and 140 man-years higher income jobs for one (1) year. 2. Create 12 low to medium income permanent jobs. 3. Provide 60 percent flood damage reduction to Kankakee River Main Stem 4. Provide 45 percent flood damage reduction to Kankakee River tributaries.	PL 83-566 Watersheds Farmers Home Administration (FmHA) Loans PL 74-46 Soil Conservation Service (SCS) technical assistance for drainage. Agricultural Stabilization and Conservation Service (ASCS) cost sharing based on annual program provisions.	County Drainage Boards - channel work. Conservancy Districts
On-farm resource management systems on 247,500 acres of cropland	Drainage Net Beneficial Effect = 1,956.1	5,365.8 5,365.8	A. Installation OM&R	2,580.6 829.1 3,409.7	1. Provide potential for increased agricultural nutrient contribution to streams	Drainage: Indirect & Induced Wages & Salaries	7,328.5 1,713.4 1,188.3 10,230.2	-1,962.7 -1,713.4 -1,188.3 -4,864.4	Installation OM&R Net Beneficial Effect (Region) = 6,820.5 (Nation) = -4,864.4	2,580.6 829.1 3,409.7		1. Create 38 low to medium income permanent jobs for region residents. 2. Create 1612 man-years low to medium income jobs and 315 higher income jobs.	PL 74-46 Soil Conservation Service (SCS) technical assistance for drainage ASCS cost sharing based on annual program provisions FmHA loans	County Drainage Board - major drainage systems. Soil and Water Conservation Districts.
Accelerated Land Treatment Program to reduce erosion and adequately treat: 349,100 acres cropland 59,300 acres grassland 18,000 acres forestland	NOTE: Accelerated land treatment program not evaluated in monetary terms.		Installation including technical assistance = 14,123.6 capital cost		1. Reduce erosion and sediment on 426,400 acres 2. Improve water quality by reducing erosion and sedimentation, and by increasing infiltration and reducing storm run-off. 3. Decrease agricultural nutrient contribution to streams. 4. Increase quantity and improve quality of wildlife habitat. 5. Temporary disruption of aesthetic quality and temporary increase in fire hazard from TSI practices.	NOTE: Accelerated land treatment program not evaluated in monetary terms			Installation including technical assistance = 14,123.6 capital cost			1. Create 18 low to medium income permanent jobs for region residents. 2. Create 520 low to medium income jobs and 130 higher income jobs for one (1) year.	PL 74-46 SCS technical and cost sharing assistance PL 83-566 watersheds (as above) Arrow Head Country RC&D project FmHA loans Forest Service State and Private Forestry Technical assistance ASCS cost sharing based on annual program provision CES Technical and Information assistance	IDNR Forestry Technical Assistance Program. IDNR Fish and Wildlife Technical Assistance Program. Soil and Water Conservation Districts.
Recreation County parks - 2700 acres Regional parks - 1500 acres Riverside recreation development - 450 acres Public access for canoeing on Kankakee, Yellow and Iroquois River - 112 miles Bridle trails along Iroquois River - 20 miles System of trails along Kankakee River and natural areas and urban centers - 37 miles.	Recreation Net Beneficial Effect = 753.6	1,507.8 1,507.8	Installation Land Rights OM&R	211.2 287.0 256.0 754.2	1. Preserve 450 acres of floodplain for natural or recreational uses. 2. Provide 1400 acres of protected area for wildlife. 3. Disrupt tranquility of rural environment and stream corridors providing public access and recreation activities for 1,211,950 recreational visits. 4. Reduce erosion on 2100 acres. 5. Extends public access to 112 miles of stream for canoeing and fishing. 6. Change 4,650 acres from private to public ownership. 7. Provide recreation opportunities for urban centers and the rural residents. 8. Remove 2100 acres from cultivation. 9. Continued maintenance on 440 acres of wildlife habitat. 10. Replace 315 acres of wildlife habitat with public recreational facilities. 11. Temporary disruption of aquatic ecosystem on 112 miles of streams.	Recreation Wages & Salaries	1,507.8 171.1 1,678.9	-171.1 -171.1	Installation Land Rights OM&R Induced (land rights) Net Beneficial (Region) = 1,089.4 (Nation) = - 335.8	96.8 143.5 256.0 93.2 589.5	114.4 143.5 -93.2 164.7	1. Create 6 low to medium income permanent jobs for region residents. 2. Create 6 low to medium income seasonal permanent jobs for region residents. 3. Create 110 man-years low to medium income jobs and 22 man-years higher income jobs. 4. Provide restricted use and development of flood prone areas, thereby reducing risk of loss of life. 5. Create 1,211,950 annual recreational visits for a mix of rural and urban population. 6. Provide opportunities for region residents to enjoy the aesthetic values of natural and scenic areas.	Arrow Head Country Resource Conservation and Development (RC&D) project. FmHA loans. Cooperative Extension Service (CES) technical assistance.	IDNR - Land & Water Conservation Fund Program IDNR - Trails Program. County, City and Town Park and Recreation Boards. U.S. Housing and Urban Development (HUD) - Community Development Act. Conservancy Districts Federal revenue sharing with local units of civil government.
Floodplain Management Program 222,000 acres	Reduction of Future Flood damage Net Beneficial Effect = 65.9	155.0 155.0	Flood prone area identification Program administration	49.1 40.0 89.1	1. Preserve over 222,000 acres of floodplain for agricultural, natural or recreational uses.	Flood prevention Wages & Salaries	155.0 62.3 217.3	-62.3 -62.3	Flood prone area identification Program Administration Net Beneficial Effect (Region) = 177.3 (Nation) = -111.4	40.0 40.0	49.1 49.1	1. Create 35 higher income jobs for one (1) year. 2. Create 2 higher income permanent jobs for region residents. 3. Allow planned development of flood prone areas at a land use intensity compatible with state law.	PL 83-566 Flood Hazard Studies	Plan Commissions Park and Recreation Boards County Commissioners Cities and Towns Local Land Zoning Ordinances
Change 12,650 acres of Class IV, VI, VII cropland to non-cropland	Net Beneficial Effect = -626.2		Installation for alternate use Land Rights	64.2 562.0 626.2	1. Reduce erosion and sedimentation by converting 11,000 acres of Class IV cropland to permanent cover of grass and 1650 acres of Class VI and VII cropland to permanent cover of trees. 2. Improve water quality by reducing erosion and nutrient contribution from 11,000 acres presently in cropland. 3. Net decreases of agricultural nutrient contribution to streams. 4. Improve wildlife habitat on 11,000 acres for species favoring grass environment and 1650 acres for species favoring forest environment. 5. Improve riparian fish and wildlife habitat.	Erosion control (land use adjustment)	324.9 324.9	-324.9 -324.9	Installation for alternate uses Land Rights Induced (land rights) Net Beneficial Effect (Region) = -564.4 (Nation) = - 61.8	64.2 562.0 263.1 889.3	-263.1 -263.1	1. Create 40 man-years low to medium income jobs and 8 man-years higher income jobs.	PL 74-46 Soil Conservation Service (SCS) technical assistance Forest Service State & Private Forestry technical assistance Arrow Head Country Resource Conservation and Development (RC&D) project Agricultural Stabilization and Conservation Service (ASCS) cost sharing based on annual program provisions	Indiana Department of Natural Resources (IDNR) Forestry Technical Assistance Program Soil and Water Conservation Districts
Protect 5,000 acres of classified wetlands and 100,000 acres of woodland habitat.	Net Benficial Effect = -100.0		Land Rights Property tax loss	50.0 50.0 100.0	1. Protect 5,000 acres of classified wetlands and 100,000 acres of woodland and related habitats.				Land Rights Property Tax Loss Net Beneficial Effect (Region) = -100.0	50.0 50.0 100.0		1. Provide opportunity for region residents to enjoy the natural, scenic and aesthetic values of the wetlands.	Water Bank Program	IDNR Fish and Wildlife Technical Assistance Program IDNR Wetlands Acquisition Program Local Land Zoning Ordinances
Protect, improve and maintain riparian habitat on 254 miles of small streams	Net Beneficial Effect = -59.9		Installation Land Rights OM&R	6.1 28.4 25.4 59.9	1. Improve stream fisheries and riparian wildlife habitat on 166 miles of streams. 2. Temporary disruption of aquatic ecosystem on 166 miles of streams. 3. Protect and maintain stream fisheries and riparian wildlife habitation on 88 miles of stream and 158 acres.	Wages & Salaries	12.8 12.8	-12.8 -12.8	Installation Land Rights OM&R Net Beneficial Effect (Region) = -47.1 (Nation) = -12.8	6.1 28.4 25.4 59.9		1. Create 2 low to medium income seasonal permanent jobs for region residents. 2. Create 4 man-years low to medium income jobs and 1 man-year higher income job. 3. Provide opportunity for region residents to enjoy the natural scenic and aesthetic values of the streams.		IDNR Fish and Wildlife technical assistance Local Land Zoning Ordinances
Basin Total	Net Beneficial Effect = 3,441.6	11,609.8		8,168.2			20,134.3	-8,524.5	Net Beneficial Effect (Region) = 13,018.7 (Nation) = -9,577.1	7,115.6	1,052.6			

* Not included in account summaries, see page IX-8 for explanation.

II. INTRODUCTION

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CHAPTER II. INTRODUCTION

This report is the result of a cooperative Type 4 interagency study of the water and related land resources of the Kankakee River Basin in Indiana. The report discusses the availability of water and related land resources to meet the present and future needs of the Basin, and presents potential alternatives from which a "Suggested Plan" was formulated to achieve orderly and beneficial utilization, development, and conservation of these resources.

A. Purpose of Study

The purpose of the study is to evaluate the water and related land resources, identify problems associated with their use and development, determine present and future needs for resource development, propose alternative plans and a Suggested Plan for the orderly development of these resources, and determine extent to which action is needed beyond the scope of available programs. The items appraised include flooding and flood damage reduction, watershed protection (land treatment), soil erosion, sedimentation, drainage, irrigation, water supply, water quality, fish, wildlife, and outdoor recreation. Opportunities for development were simultaneously evaluated in physical, economic, and/or environmental terms.

B. Authority for Study

Authority for USDA participation in this study is the Watershed Protection and Flood Prevention Act of the 83rd Congress (Public Law 83-566, as amended). The Secretary of Agriculture is authorized to cooperate with other federal, state, and local agencies in the investigation of watersheds, rivers, and other waterways to identify potential water resource developments and coordinated programs. The State of Indiana is authorized to participate through the Indiana Flood Control Act, 1945, Sections 2 and 11.

C. Nature of Study

The study included an evaluation of the importance of agriculture and related economic activities to the Basin, the State of Indiana, and the nation. Aspects analyzed and projected include land use, output of agricultural products, agricultural employment, and expected shifts of agricultural land to other uses. Projections were made of the need for developing water and related land resources for food production, rural and municipal water supply, and water-oriented recreation.

Resource developments required to meet short and long range needs were identified. An early action plan was developed to meet projected needs for the year 1990. Opportunities for meeting long range projected needs for 2020 were considered in lesser detail.

Opportunities and solutions were identified that can be carried out by private groups; individuals; the U.S. Department of Agriculture; and other federal, state, and local agencies under existing authorities, and those activities that should be developed under amended or new authorities. The impacts of the proposed programs upon physical, economic, social, and environmental factors were evaluated. The effect that any potential development will have downstream in Illinois were assessed for the Suggested Plan.

Two physical study areas have been used in the analysis and report. The Kankakee River Basin Economic Area includes all of Lake, Porter, LaPorte, St. Joseph, Newton, Jasper, Starke, Marshall, and Benton Counties. The Kankakee River Basin contains only the watershed (hydrologic drainage area) of the Kankakee River in Indiana. Total Economic Area is 4,148 square miles, while the Basin encompasses 2,996 square miles. The Economic Area is a geographic base more suitable for discussion of historical demographic and economic data and future projections. Most basic economic data are available on a county basis. Basic data pertaining to physical characteristics are more readily obtainable for the Basin area.

D. Description of the Basin

The Kankakee River Basin, comprising approximately 2,996 square miles in northwest Indiana, is a part of the Illinois River Basin. It occupies a portion of Land Resource Areas 98, 110, 111 which are the Southern Michigan Drift Plain, the Northern Illinois and Indiana Heavy Till Plain, and the Indiana and Ohio Till Plain, respectively. Topography is flat to moderately rolling. There are several natural lakes in the Basin. The Economic Area was refined to Sub-Areas having boundaries on township lines approximating the Basin boundary. The Sub-Area population is 352,841. South Bend has a population of 125,580 with the remainder somewhat equally shared by rural and urban areas.

Agriculture is an important economic activity in this area where industrial and business growth has been rapid in recent years. General farms are the most common with corn, soybeans, wheat, and hay being the principal crops. Many farms also produce livestock, dairy, and poultry products. Farm ownership is held by owner-operators to a lesser extent than is average for Indiana.

Lakes are used for water sports and fishing. Cabins and houses often exist near the rivers and lakes. Wetlands are valuable wildlife habitat. Principal mineral resources are sand, gravel, limestone, dolomite, marl and peat. Sand and gravel are mined at many locations and account for most of the activity in mineral extraction.

Ground-water resources are good throughout the Basin. Ground-water is most abundantly available in a wide band along the Kankakee River.

E. Sponsoring and Cooperating Agencies Participating in Study

The U.S. Department of Agriculture participated in accordance with the Memorandum of Understanding between the Economic Research Service (ERS), the Forest Service (FS), and the Soil Conservation Service (SCS) dated February 2, 1956, and revised April 15, 1968. The State of Indiana participated in this study through the Department of Natural Resources (IDNR), the Department of Commerce, and the State Board of Health. U.S. Geological Survey also participated in the study. In March 1971, the State of Illinois indicated that they were not in a position to participate in an extension of the study to include the Illinois portion of the Basin; however, they did accept an invitation of the State of Indiana to attend, as an observer, meetings of the various study committees.

F. How Study was Made

A Plan of Work for this study was prepared by the participating agencies of both the U.S. Department of Agriculture and the State of Indiana. The Plan of Work outlined a study structure which consisted of a USDA Field Advisory Committee, a Coordinating Committee, a Plan Formulation Subcommittee, a Public Information Subcommittee, and seven task forces. Interested local citizens and organizations participated as an Advisory Group.

1. The Field Advisory Committee (FAC) guided and coordinated the Department of Agriculture survey activities. This Committee was composed of the State Conservationist, Soil Conservation Service, Indianapolis, Indiana; the Leader, North Central Resource Group, Economic Research Service, East Lansing, Michigan; and the Field Representative, River Basin Survey, Forest Service, Carbondale, Illinois. The State Conservationist, SCS, served as chairman of the FAC, and by virtue of this chairmanship he was a member of the Coordinating Committee.

   Each of the involved Department of Agriculture agencies was designated responsibility for aspects of the survey which were within their respective capabilities.

2. The Coordinating Committee consisted of representatives from the following agencies.

   Department of Natural Resources, State of Indiana (Chairman)
   State Planning Services Agency, State of Indiana
   Indiana State Board of Health
   U.S. Department of Agriculture, Field Advisory Committee Chairman
   U.S. Department of the Interior, Geological Survey

   The Coordinating Committee gave general direction to the study.

3. Membership of the Plan Formulation Subcommittee consisted of representatives from:

   Soil Conservation Service, USDA (Chairman)
   Economic Research Service, USDA
   Forest Service, USDA
   Indiana State Board of Health
   Bureau of Water and Mineral Resources, IDNR, State of Indiana
   Bureau of Land, Forest and Wildlife Resources, IDNR, State of Indiana
   State Planning Services Agency, State of Indiana

   The Plan Formulation Subcommittee served the function of establishing schedules, reviewing progress, and co-ordinating study activities. Task force co-chairmen normally attended the Subcommittee meetings to present data developed by the task forces. The Subcommittee developed and evaluated alternative plans and made recommendations to the Coordinating Committee.

4. The Public Information Subcommittee was responsible for the preparation and dissemination of all news releases. Subcommittee members were assigned from the following agencies:

   Soil Conservation Service, USDA (Co-chairman)
   Department of Natural Resources, State of Indiana (Co-chairman)
   State Planning Services Agency, State of Indiana
   Indiana State Board of Health
   Cooperative Extension Service, Purdue University

   This Subcommittee was responsible for the collection of pictures, color slides, visual aids, and other information. The committee also prepared a condensed (Summary) version of this report.

5. The Task Forces were comprised of specialists from several agencies and members of the Advisory Group. Task forces were charged with the responsibility of investigating problems and needs within their assigned areas and reporting to the Plan Formulation Subcommittee. Following is a listing of the seven task forces, the agencies that provided representatives, and a brief description of the general assignments:

   a. Task Force #1, Economic and Demographic, Co-chaired by representatives of Economic Research Service, USDA, and Department of Natural Resources, State of Indiana. This Task Force developed data for the projection of population, employment, income, and land use. These projections were used by other task forces to determine requirements for the conservation, utilization and management of water and related land resources.

b. Task Force #2, Hydraulic and Hydrology, Co-chaired by representatives of Soil Conservation Service, USDA and Department of Natural Resources, State of Indiana. This group inventoried data on streams, lakes, and ground water for use in analyzing flooding, water supply, water quality, recreation, and related fish and wildlife resources. The hydrologic effects of project proposals were studied and these results were furnished to other study participants.

c. Task Force #3, Fish and Wildlife, Co-chaired by representatives of Soil Conservation Service, USDA and Department of Natural Resources, State of Indiana. This Task Force inventoried fish and wildlife resources. Studies were conducted on the utilization of these resources. Estimates were prepared on future demands, and the effects of land and water resource development plans considered in this study were analyzed.

d. Task Force #4, Environmental and Recreational, Co-chaired by representatives of Department of Natural Resources, State of Indiana and Soil Conservation Service, USDA. The existing land and water oriented recreation resources and facilities were inventoried. Future outdoor recreation needs were determined and used in making estimates of the Basin needs for water and related land resources required to satisfy these demands.

   Adverse environmental sites were inventoried. Historical, archaeological, and natural sites were listed with associated needs and potentials for their preservation, protection, and enhancement.

   Proposed land and water resource projects were studied by this Task Force in view of determining their effects upon the environmental and recreational values in the Basin.

e. Task Force #5, Water Supply and Water Quality, Co-chaired by representatives of Soil Conservation Service, USDA and Indiana State Board of Health. This group compiled the requirements for all water uses. Inventories were compiled on water quality related data. The Task Force considered various alternative means for meeting the water supply needs. This Task Force was also responsible for preparing the data on electric power generation in the Basin.

f. Task Force #6, Land Resources, Co-chaired by representatives of Soil Conservation Service, USDA, and Department of Commerce, State of Indiana. This Task Force obtained and analyzed data regarding existing land use, future demands for land, and the effects of resource development plans upon the land. Mineral resources data were obtained and analyzed by this Task Force.

g. Task Force #7, Flood Damage Reduction, Co-chaired by representatives of Department of Natural Resources, State of Indiana and Soil Conservation Service, USDA. Responsibilities of this group included delineating flood plains, establishing current and projected average annual flood damages, and studying alternative plans and programs for flood damage reduction and drainage improvement.

In addition to the Co-chairman, each task force included about ten additional members. These members were drawn from the agencies named above and from the Forest Service, USDA; Purdue University; Indiana University; and the Agricultural Research Service (USDA).

6. The Advisory Group was comprised of people with varied occupations including representatives of special interest groups such as soil, water, fish, wildlife, and recreation; university employees; and city and county officials. Most of these people are residents of the Kankakee River Basin and volunteered to serve in consultant capacities with task forces. This group supplied local input to the study at the eight Coordinating Committee meetings opened to the public as well as through task force activities.

The study participants utilized available published and unpublished data and developed additional data as needed. The Kankakee River Basin was divided into 35 hydrologic units for purposes of studying water problems. In addition to this major breakdown, the Main Stem Kankakee River flood plain was divided into 22 reaches. Field reconnaissance, interview, and engineering surveys were conducted. Maps were prepared to show general soil association; ground-water availability; ground-water level; hydrologic station; wildlife habitat classification; fishery habitat classification; flood plains; and recreation, historic, scenic, and natural areas.

G. Use That Can be Made of Report

This report will be used by the State of Indiana in the formulation of the Kankakee River Basin portion of the State Water Plan. The survey will assist the U. S. Department of Agriculture

in making the most effective use of its land and water conservation and development programs. It will also serve as a guide in coordinating water and related land resource development programs and projects of local, state, and federal agencies and private groups and individuals. The identification of problems, needs, and opportunities presented in this report can be one of the tools used in planning for optimum water and related land resource development. Planners can avoid conflicts by considering the data and information presented.

The basic data collected and used in this study are on file at the Soil Conservation Service, Suite 2200, 5610 Crawfordsville Road, Indianapolis, Indiana 46224; U.S. Forest Service, Forestry Science Laboratory, 180 Canfield Street, Morgantown, West Virginia 26505; Economic Research Service, 1405 South Harrison Road, East Lansing, Michigan 48823; and State of Indiana, Department of Natural Resources, State Office Building, 100 North Senate Avenue, Indianapolis, Indiana 46204.

H. Acknowledgements

In addition to the agencies actively participating; cooperation, data, and assistance were provided by the following, to whom appreciation is hereby expressed:

U.S. Department of Agriculture
- Agricultural Stabilization and Conservation Service
- Farmers Home Administration
- Statistical Reporting Service
- Federal Extension Service
- Agricultural Research Service

U.S. Department of the Interior
- Bureau of Outdoor Recreation
- Fish and Wildlife Service

U.S. Department of Commerce
- National Oceanic and Atmospheric Administration

U.S. Department of Defense
- Army Corps of Engineers (Chicago District)

State Agencies
- Indiana State Highway Commission

Other

- Soil and Water Conservation Districts
- Purdue University
- Indiana University
- Valparaiso University
- County Officials
- Local Residents
- South Bend (Ind.) Audubon Society

III. ENVIRONMENTAL SETTING - BASIN RESOURCES

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CHAPTER III.
ENVIRONMENTAL SETTING-BASIN RESOURCES

A. Physical Data

1. Location, Size, Cities, Population, and Relation to Other River Systems.

The Kankakee River Basin is located in northwestern Indiana and northeastern Illinois. This entire area encompasses 5,165 square miles of which 2,169 are in Illinois and 2,996 are in Indiana (See Plate 1). Adjacent river systems are the Elkhart River Basin to the east, the Wabash River Basin to the south, and Illinois River Basin to the west, and the Calumet River Basin to the north.

This study is directed primarily toward the Indiana portion of this area which includes portions of 13 counties in northwestern Indiana. The Indiana portion will be referred to as the "Basin" in this report. The population of the Basin is approximately 352,800. Cities and towns account for about 225,000 as shown on Table III-1. Rural population is approximately 128,000.

In addition to the Basin as described in the preceding paragraph the nine-county area of Benton, Jasper, Lake, LaPorte, Marshall, Newton, Porter, St. Joseph and Starke Counties is discussed. This nine-county area is referred to as the Kankakee River Basin Economic Area, or the Economic Area, and comprises 2,666,880 acres (See Table III-2). The use of the Economic Area is necessary because a large part of basic information is available only on a county basis. The Economic Area is within Indiana Planning Regions 1, 2 and 4 1/, which constitute the "region" as used in Chapter IX.

2. Soil and Water Resource Problems

Proper use and management of the land for sustained agricultural production is a basic need in the conservation, development, and utilization of land and water resources. Of the Basin's 1,340,210 acres of cropland, about 188,900 acres have a dominant erosion hazard, 151,000 acres have unfavorable soil conditions (primarily droughtiness), and about 851,500 acres have excess water problems. Approximately 36,000 acres of cropland and 2,500 acres of grassland need land use conversion to less intensive uses.

1/ Includes the counties of Lake, Porter, LaPorte, Newton, Jasper, Pulaski, Starke (Region 1); St. Joseph, Elkhart, Marshall, Koscuisko (Region 2); and Benton, Warren, Fountain, White, Tippecanoe, Montgomery, Carroll, Clinton (Region 4); Indiana Fact Book, Indiana Department of Commerce, Oct. 1971.

TABLE III - 1 CITIES AND TOWNS
Kankakee River Basin, Indiana

County		City or Town	1970 Population
Jasper		Demotte	1,697
		Wheatfield	713
		Remington	1,127
		Rensselaer	4,688
Lake		Cedar Lake	7,589
		Lowell	3,839
		Schneider	426
	*	Crown Point	10,931
Porter		Hebron	1,624
		Kouts	1,388
Benton		Earl Park	478
	*	Fowler	2,643
Newton		Brook	919
		Goodland	1,176
		Kentland	1,864
		Morocco	1,285
		Mount Ayr	194
Laporte		Hudson Lake	1,134
		Kingsbury	314
		Kingsford Heights	1,200
		LaCrosse	696
		Laporte	22,140
		Pine Lake	1,954
		Wanatah	773
		Westville	2,614
Starke		Hamlet	761
		Knox	3,519
		North Judson	1,738
Marshall		Argos	1,393
		Bremen	3,487
		LaPaz	604
		Plymouth	7,661
St. Joseph		Lakeville	712
		Lydick	1,341
		New Carlisle	1,434
		North Liberty	1,259
	*	South Bend	125,580
		Walkerton	2,006
			224,901

* Part of Corporation in Basin

TABLE III - 2: LAND USE DISTRIBUTION

Kankakee River Basin, Indiana

Land Use	Economic Area 1/		Basin 2/	
	Acres	Percent 3/	Acres	Percent 4/
Inventory				
Cropland	1,796,000	67.3	1,340,210	69.9
Pasture	151,800	5.7	118,480	6.2
Forest	188,300	7.1	142,160	7.4
Other	297,200	11.1	166,010	8.6
Subtotal	2,433,300	91.2	1,766,860	92.1
Non Inventory				
Federal Noncropland 5/	2,400	0.1	2,400	0.1
Urban and Built-up	206,300	7.8	130,130	6.8
Small Water Areas 6/	13,700	0.5	10,450	0.6
Subtotal	222,400	8.4	142,980	7.5
Inland Water 7/	11,180	0.4	7,600	0.4
Total	2,666,880	100.0	1,917,440	100.0

Source: Indiana Soil and Water Conservation Needs Inventory (1968) and Bureau of Census.

1/ Total area of Benton, Jasper, Lake, LaPorte, Marshall, Newton, Porter, St. Joseph and Starke Counties.

2/ Total hydrologic (watershed) drainage area of the Kankakee River (in Indiana).

3/ Percent of total Economic Area.

4/ Percent of total Basin.

5/ All federal land except land operated under lease or permit.

6/ Areas less than 40 acres and streams less than one-eighth mile wide.

7/ Areas larger than 40 acres and streams greater than one-eighth mile wide.

Flooding occurs on over 222,000 acres in the Basin, of which over 180,000 acres are cropland. About 106,000 acres and 86,000 acres, respectively, are situated along the Kankakee River. The excess water problem areas often occur in conjunction with flooding to form joint flooding - impaired drainage problem areas.

Soil erosion from water and wind is relatively low; however, sloping lands along the northern and eastern periphery of the Basin produce a major portion of the total soil losses. Sediment problems from the various types of erosion in this Basin do not appear as severe as in some adjoining areas. Suspended sediment records indicate the Kankakee River waters are among the lowest in Indiana from the standpoint of suspended sediment. There are, however, locally significant damages which result from the accumulation of sediment in channels.

There are identified immediate needs for increased recreational opportunities within the Economic Area, particularly land-based activities such as camping, hunting, and various types of trails (bicycling, hiking, bridle, and nature). Major water-based activities are needed for water skiing, canoeing, and boating.

Fish and wildlife habitat are significant resources of the Basin and are in need of increased protection and maintenance for proper utilization. Those wildlife species most affected by lack of adequate habitat protection are those dependent on woodland. There is a need to protect existing wood lots and forest land along water courses, and to utilize non-productive cropland areas as forest land or grassland.

Increased public utilization of areas along stream courses which have attractive scenic and aesthetic qualities is a current need. Today's problem of limited access is expected to grow in the face of increasing urbanization and other development.

3. Land Resource Base

The 48 conterminous states of the United States have been divided into 156 major land resource areas. A land resource area (LRA) is a large geographic unit of land with similar characteristics of soil, climate, geology, vegetation, topography, and agricultural development. These areas are comprised of lands which are similar with regard to the types and severity of soil management problems encountered. Contrasts between land resource areas are usually, but are not always, distinct and readily discernible.

These 156 major land resource areas have been grouped into 20 land resource regions. The major consideration in this grouping has been to retain as much similarity as possible in the general characteristics of agriculture within each region.

The Kankakee River Basin includes portions of three land resource areas which are in two different land resource regions. Land

Resource Area 98 (Southern Michigan Drift Plain) is dominant, comprising about half the Basin area.

The upper portion of the Basin and the main stem are in this land resource area. Land Resource Area 110, Northern Illinois and Indiana Heavy Till Plain, comprises about one-third of the Basin, making up most of the Iroquois drainage and the northwestern portion of the Kankakee Basin. Land Resource Area 111, Indiana and Ohio Till Plain, comprises about one-sixth of the Basin and encompasses the upper Yellow River drainage area.

Within these three land resource areas the soils of the Kankakee Basin have been grouped into 25 soil associations. These soil associations, along with brief descriptions, are shown on the General Soil Map, Plate-2. Soil associations are delineated on the basis of the dominant soils and their characteristics. There are, of course, usually several other soils mapped within each association.

A further means by which soils are grouped and categorized is the capability classification system. In this system soils are grouped according to their limitations for agricultural production. It is a method whereby soils can be grouped and recommendations made in regard to their use, treatment and management. The capability classication system consists of three major categories: (1) capability class; (2) capability subclass; and (3) capability unit.

a. Land Capabilities

The broadest category in the classification system places all soils in one of eight <u>capability classes</u> which are designated Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use and are defined as follows:

Class I - Soils with few limitations that restrict their use.

Class II - Soils with moderate limitations that reduce the choice of plants or require moderate conservation practices.

Class III - Soils with severe limitations that reduce the choice of plants, require special conservation practices, or both.

Class IV - Soils with very severe limitations that restrict the choice of plants, require very careful management, or both.

Class V - Soils are subject to little or no erosion but have other limitations, impractical to remove, that limit their use largely to pasture, range, woodland or wildlife food and cover.

Class VI - Soils have severe limitations that make them generally unsuitable for cultivation and limit their use largely to pasture, range, woodland, or wildlife food and cover.

Class VII - Soils with very severe limitations that make them unsuitable for cultivation and that restrict their use largely to pasture, range, woodland, or wildlife.

Class VIII - Soils and landforms have limitations that preclude their use for commercial plant production and restrict their use to recreation, wildlife, water supply, or aesthetic purposes.

The capability classes are further divided into <u>subclasses</u> based on the principal limiting problem. They are designated by adding a small letter, "e", "w", "s", or "c" after the capability class numeral.

The letter "e" indicates that the main limitation is risk of erosion; "w" shows that excess water in or near the soil surface interferes with plant growth or cultivation; "s" indicates that the soil is limited mainly because it is shallow, droughty, or stoney; and "c" is used in some parts of the country (not the Kankakee Basin) where the climate is too cold or too dry. In capability Class I there are no subclasses because these soils have few, if any, limitations.

<u>Capability units</u> are the most detailed grouping in the classification system. The soils in any one capability unit are similar enough to be suited to the same crop and pasture plants, to require similar management, and to be similar in productivity and other responses to management. They are usually designated by adding an arabic numeral after the capability class and subclass designation as IIe6 or IIIw6. Class I soils may be divided into capability units even though they have no capability subclass designation, e.g. I-1 and I-2.

b. Land Use by Capability Class

Table III-3 shows the present major land use by capability class for the Kankakee River Basin. Approximately 10 percent of the area, or 177,240 acres, is Class I land. There are 148,890 acres of Class I cropland, all of which are suited for a wide range of plants and requires only good management for sustained intensive cultivation.

Class II land is dominant and comprises 791,610 acres or approximately 45 percent of the Basin area and accounts for more than 48 percent of the Basin cropland. For use as cropland, these soils require conservation practices such as residue manage-

TABLE III - 3 : MAJOR LAND USE BY CAPABILITY CLASS 1/
Kankakee River Basin, Indiana

	Soil Class							
	I		II		III		IV	
Land Use	Acres 2/		Acres		Acres		Acres	
Cropland	148,890	(11.1)	646,360	(48.2)	352,350	(26.3)	185,930	(13.9)
Pastureland	8,020	(6.7)	50,340	(42.5)	31,150	(26.3)	24,420	(20.6)
Forestland	7,540	(5.3)	39,860	(28.0)	28,750	(20.2)	56,650	(39.9)
Other	12,790	(7.7)	55,050	(33.2)	50,890	(30.6)	36,540	(22.0)
Total	177,240	(10.0)	791,610	(44.8)	463,140	(26.2)	303,540	(17.2)

	Soil Class						
	VI		VII		VIII		Total
Land Use	Acres		Acres		Acres		Acres
Cropland	5,190	(0.4)	1,490	(0.1)	-	-	1,340,210
Pastureland	3,280	(2.8)	1,270	(1.1)	-	-	118,480
Forestland	7,490	(5.3)	1,870	(1.3)	-	-	142,160
Other	6,110	(3.7)	2,990	(1.8)	1,640	(1.0)	166,010
Total	22,070	(1.3)	7,620	(0.4)	1,640	(0.1)	1,766,860

Source: Indiana Soil and Water Conservation Needs Inventory

1/ Does not include non-inventoried acreage of federal non-cropland, water areas, and urban and built-up land.

2/ Figures in parenthesis refer to the percentage of major land use within the capability class.

ment and annual cover crops on the 126,550 acres of "e" subclass soils and on the 34,830 acres of "s" subclass soils, and adequate drainage is required on the 484,980 acres of "w" soils which are presently in cropland.

Approximately 26 percent of the area consists of Class III soils which accounts for a corresponding portion of the Basin cropland acreage. The 44,680 cropland acres of Class III soil with an erosion hazard ("e" subclass) show a strong need for contour farming, strip-cropping, terraces, and diversions along with conservation cropping systems.

There are 67,950 acres of IIIs soils in cropland, more than half of which need annual cover crops, crop residue management, or sod in the rotation and grassed waterways. The IIIw soils in cropland comprise 239,720 acres and need improved drainage in addition to conservation cropping systems for more efficient agricultural production.

Class IV soils comprise about 17 percent of the Basin area and 14 percent of the Basin cropland. There are 16,200 acres of these soils with an erosion hazard in cropland use on which the major needs are strip-cropping, terraces, diversions, and in some cases a change to permanent cover of grass or trees. There are 126,800 cropland acres of IVw soils which need drainage improvement and conservation cropping systems in order to efficiently remain in crop production. There are 42,930 acres of IVs soils in cropland on which major needs range from residue management and annual cover crops to a change to permanent cover.

There is no Class V land in the Basin.

About 1 percent of the Basin area is Class VI land, which is less than 1 percent of the cropland. The 1,250 acres of VIe soils and the 3,940 acres of VIs soils in cropland use have needs to include residue and annual cover, sod in the rotation, and in some cases a change to permanent cover.

Less than one half of 1 percent of the Basin area is in Class VII land which comprises only one-tenth of 1 percent of the Basin cropland. These areas comprise 1,490 acres of cropland, all of which are subject to severe erosion.

Class VIII lands comprise less than one-tenth of 1 percent of the Basin area and none of the Basin cropland.

Most of the forestland within the Basin is found in soil associations 2,3,7,16,17, and 23 (See Plate 3). The principal soils in soil associations 16 and 17 are Maumee, Rensselaer, Plainfield, and Gilford. The most desirable tree species to be found growing on these soils are pin oak, red maple, black ash, aspen, white ash, and sweet gum. Species desirable for tree planting include

white pine, European larch, and black spruce. Site indexes 1/ for some of the species are; 65-75 for pin oak, 70-80 for white pine, and 65-75 for aspen. These sites are capable of producing 155-220 board feet per acre per year on site index 65-75 soils and up to 185-260 board feet per acre per year on the 70-80 site index soils.

The principal soils in soil associations 2 and 3 are Plainfield, Brems, Morocco, Tyner, and Oshtemo. The most desirable tree species to be found growing on these soils are red maple, pin oak, black oak, and black cherry. Site indexes for some of the species are 65-75 for white pine and upland oaks, and 85-95 for pin oak. These sites are capable of producing from 155-220 board feet per acre on the 65-75 site index soils and up to 300-375 board feet per acre on the 85-95 site index soils. Species desirable for tree planting are white pine, red pine, scotch pine, jack pine, red maple and sycamore.

The principal soils in soil association 32 are Genessee and Eel. The most desirable tree species to be found growing on these sites include cottonwood, sycamore, tulip poplar, black walnut, and white ash. The site index for tulip poplar ranges from 95 to 105 with a corresponding production potential of from 375 to 450 board feet per acre. Species most desirable for tree planting include white pine, black walnut, tulip poplar, and black locust.

c. Soils

The General Soil Map (Plate 2) gives a visual reference to the variations of soils and associated geology of the Basin. Plate 2 also contains the description and grouping of soil associations by dominant drainage, slope and texture characteristics. Following the General Soil Map is the Soil Interpretations (Plate 3) which provides estimated soil limitations or suitability for selected uses for each of the 25 soil associations identified in the Basin.

Additional information, more suitable for intensive planning for specific areas, can be found in detailed soil survey reports available for most of the Basin. Modern soil surveys have been completed and published in Lake, Newton, and Pulaski Counties; have been completed and will be published in St. Joseph County; and are being conducted in LaPorte, Marshall, and Porter Counties. Older published soil surveys are available for Benton and Starke Counties. No published soil survey is available for Jasper County.

1/ Site index is the height in feet of average dominant and co-dominant trees at a specified age (50 years in this case).

d. Geology, Physiography, and Topography

The Indiana portion of the Kankakee River Basin consists of a mantle of unconsolidated glacial deposits overlying bedrock of Paleozoic age. The glacial deposits, known collectively as glacial drift, range in thickness from a few feet to more than 300 feet, averaging greater than 100 feet in most of the Basin. These glacial deposits are primarily responsible for the present landscape and for most of the mineral deposits previously mined in the Basin. The topography can be characterized as nearly level to gently sloping except areas near the northern boundary and in the eastern portions which are moderately rolling to locally steep. Land elevations range from about 625 feet above mean sea level at the Illinois-Indiana boundary to 950 feet about three miles northwest of Rolling Prairie in LaPorte County.

The dominant physiographic feature of the Basin (in Indiana) is a broad outwash plain known as the Kankakee Outwash and Lacustrine Plain. It ranges from about 15 to 25 miles wide throughout its extent from South Bend to the Indiana-Illinois state line. This outwash plain consists primarily of sand and gravel represented on Plate 4 by map units (Q_G and Q_S), and it is characterized by a relatively shallow ground-water level. Sand ridges (Q_{SD}) are scattered throughout much of the area, breaking the relatively flat and monotonous landscape. This area is bordered on the north by a portion of the Valparaiso Morainal Area, an arcuate end-moraine complex that ranges up to 150 feet above the Outwash Plain. The Valparaiso Morainal Area is characterized by heterogeneous deposits of clay, silt, sand, and gravel (Q_{TE}) containing usually discontinuous layers or lenses of sand and/or gravel. Within this morainal complex there are ice-block depressions, some of which contain lakes and some filled with organic materials.

To the south, the Outwash Plain is bordered by end-moraine (Q_{TE}), ground moraine (Q_T) and deposits of glacial till. Much of the area is nearly level to gently rolling ground moraine with a few end-moraine deposits which have slightly greater relief.

This till plain encompasses areas of lake-deposited silts, clays (Q_{CL}), sands (Q_{SL}), outwash sand (Q_G), eolian dune sand (Q_{SD}), alluvial silts, sands, and clays (Q_{SA}), marsh or lake deposits of marl, peat or muck (Q_{MP}), and ice-contact stratified deposits of sand and gravel (Q_{GK}).

The Outwash Plain merges to the east with the Steuben Morainal Lake Area which is a topographically complex area in which local relief of 100 to 150 feet is not uncommon. In some places, local relief may exceed 200 feet. This morainal lake area consists of a complex array of glacial tills, lacustrine deposits, outwash deposits, alluvial materials, and ice-contact drift in a variety of depositional and erosional features.

Topographically high areas or knobs are often composed of glacial till (Q_T or Q_{TE}); however, many are ice-contact sand and gravel (kame) deposits (Q_{GK}). Ice-block depressions (kettle) serve as basins for many of the natural lakes and marsh areas that are characteristic of this area. Melt-water channels, also part of the complex physiography, are represented by outwash sand and gravel deposits and associated organic materials.

The underlying bedrock consists of crystalline basement rocks overlain by approximately 4,000 feet or more of predominantly limestones, dolomites, and shales of Paleozoic age. Bedrock which crops out beneath the glacial drift ranges in age from Ordovician to Pennsylvanian. In over 90 percent of the Basin, Silurian and Devonian age rocks crop out beneath the glacial drift (See Plate 5). With the exception of two small areas on the southern boundary, Devonian shales crop out in the entire northeastern portion of the Basin. Toward the southwest, Devonian and Silurian dolomites and limestones are the dominant materials that crop out beneath the drift. The bedrock outcrop in the extreme southwestern part of the Basin (Iroquois River drainage area) is characterized by Devonian shale and by interbedded siltstone and shale of Mississippian age, with lesser amounts of sandstone and limestone. Ordovician and Pennsylvanian rocks crop out only in the Kentland Distrubed Area (Plate 5).

e. Mineral Resources

The production of mineral resources is from the unconsolidated deposits and bedrock of the Basin. Principal commodities produced in the past include sand, gravel, limestone, dolomite, marl, and peat. The following discussion is a very brief summary of present and potential mineral production in the Basin. Specific information on mineral production in Indiana is contained in "Bureau of Mines Minerals Yearbook", published annually by the U.S. Department of the Interior. Additional information is available from numerous publications of the Indiana Geological Survey, Bloomington.

Sand and gravel are the most widespread mineral resources produced in the Basin. In 1970, sand and gravel were quarried in 7 of the 9 counties included in the Basin.

Limestone and dolomite are quarried in Jasper, Lake, and Newton Counties for crushed aggregate and agricultural limestone.

Peat and marl are two mineral commodities that have declined in importance, probably because of the limited size of the deposits. Although numerous inactive or abandoned pits or unworked deposits are located throughout much of the Basin, the only production reported for 1970 was Marshall County.

Recent studies have indicated that a mining complex is a possibility for northern Indiana, particularly in LaPorte County and

perhaps Marshall County. Limestone, gypsum, anhydrite, and perhaps shale could be mined from the same operation. These raw materials are potential sources of sulfur, sulfuric acid, wallboard and other gypsum products, crushed stone, agricultural limestone, portland cement, and perhaps expanded shale lightweight aggregate. Rooney and Ault 1/ have indicated that it may be economically feasible to develop sources of limestone in Lake and LaPorte Counties and less probably in Marshall County. The source would be Silurian and Devonian bedrock which could be surface mined in southern Lake County and adjoining parts of Newton and Jasper Counties where the glacial drift is thin and overlying Devonian and Mississippian shales are absent or very thin. Elsewhere, specifically in LaPorte and Marshall Counties, it would be necessary to mine the Devonian limestone by underground methods.

Rooney 2/ discusses the gypsum deposits of northern Indiana and concludes that exploration by industry may find commercial deposits of gypsum within 50 miles of Chicago. Interbedded with dominantly fine-grained dolomite and limestone of the Detroit River Group (Plate 5), the gypsum and anhydrite deposits within the Kankakee River Basin appear to be thickest in LaPorte and Marshall Counties; however, commercial deposits can be developed in very small areas and further exploration may reveal thick gypsum deposits in places where current data indicates insufficient thickness.

Ronney and Sunderman 3/ have studied the potential of the New Albany Shale (Plate 5) as a raw material of expanded shale lightweight aggregate in northern Indiana and concluded that it has suitable characteristics. They report two areas where detailed mapping has shown the glacial drift is thin: one near Remington in Jasper County and the other near LaCross in LaPorte County. These two areas are considered sources of raw material for lightweight aggregate. Both are favorably located with respect to population centers and transportation.

1/ Rooney, L.F. and Ault, C.H., 1970, Potential limestone and dolomite resources of northern Indiana, in Proceedings of the Fifth Forum of Geology of Industrial Minerals. Pennsylvanian Geol. Survey Mineral Resources. Rep. M-64, p., 179-224. Reprints available from the Indiana Geological Survey, Bloomington.

2/ Rooney, L.F., 1965, Gypsum deposits in northern Indiana: Mining Engineers Trans. V. 232, p. 268-273.

3/ Rooney, L.F., and Sunderman, J.A., 1964, Lightweight aggregate potential of the New Albany Shale in northwestern Indiana: Indiana Geological Survey Rep. Prog. 27, 40 p.

f. Climatological Data

The climate of the Kankakee River Basin is classified as humid continental. Frequent changes in the weather occur from day to day and from season to season. This Basin is in the path of cold air moving out of Canada and warm, moist gulf air from the south. Frequent eastward passage of cyclonic storms across the Basin cause moderate cloudiness and windiness. Tornadoes can and do occur in this area. (See Plate 6, Hydrologic Data Network), for location of weather stations.

Summer weather is moderately warm and humid. The freeze free period of a typical year extends from May 1 through October 10 for an average of about 160 days. Winter weather brings severe cold with several days of sub-zero temperatures expected each winter. Snowmelt rarely causes flood flow in Basin streams. Specific climatic data are discussed in the following paragraphs.

(1) Precipitation

Mean Annual. Precipitation, including snowfall, varies from year to year as well as seasonally within any year. The average annual precipitation is about 36 inches. Table III-4 presents mean annual precipitation data for stations in or near the Basin. Rainfall data from the LaPorte station are inconsistent with surrounding station data and should be used with caution.

Maximum and Minimum Annual. The maximum annual recorded precipitation that has occurred in the Kankakee River Basin is about 71 inches at the LaPorte station and about 55 inches at the Plymouth substation. The minimum annual recorded rainfall is about 23 inches at the Medaryville State Nursery station.

Monthly Distribution. The mean monthly precipitation for selected stations is presented on Table III-4 and Figure III-1. The greatest precipitation normally occurs in summer months and the least in winter months.

(2) Snowfall

Snowfall in the Kankakee Basin may be heavy and will vary by location and from year to year. As can be seen by Table III-5 and Figure III-2, December and January usually have the heaviest snowfall. Snowfall is influenced by the proximity of Lake Michigan. LaPorte and South Bend vicinities record the greatest total snowfall while the least is found at Fowler.

(3) Evaporation

Evaporation and transpiration are important to stream low

TABLE III - 4 MEAN MONTHLY AND ANNUAL PRECIPITATION - FOR YEARS OF RECORD INDICATED

Kankakee River Basin, Indiana

MONTH	COLLEGE-VILLE 65 Yr.	FOWLER 30 Yr.	KENTLAND 20 Yr.	LAKE-VILLE 10 Yr.	LAPORTE 65 Yr.	MEDARY-VILLE 10 Yr.	PLYMOUTH 55 Yr.	SHELBY 10 Yr.	SOUTH BEND 21 Yr.	VALPA-RAISO 62 Yr.	WHEAT-FIELD 44 Yr.
					Inches						
JAN	2.08	1.88	1.84	1.98	2.67	1.73	2.08	1.51	2.32	2.06	1.96
FEB	1.92	1.92	2.15	1.98	2.62	2.10	1.90	1.84	2.04	1.90	1.74
MAR	3.00	2.73	2.67	2.36	3.38	2.24	2.76	2.42	2.73	2.95	2.70
APRIL	3.88	3.69	4.30	4.03	3.91	4.28	3.60	3.98	3.82	3.56	3.90
MAY	4.53	3.94	4.46	3.21	4.73	2.99	3.99	3.43	3.59	4.09	3.68
JUNE	4.02	4.36	4.30	4.12	4.60	4.70	4.53	4.04	3.55	3.96	3.99
JULY	3.74	3.78	3.78	4.14	3.78	3.95	3.37	4.40	3.47	3.24	3.12
AUG	3.43	2.72	3.12	3.62	3.91	3.33	3.20	2.77	3.44	3.50	3.39
SEPT	3.39	3.15	2.32	2.10	3.68	1.75	3.09	2.15	2.84	3.23	3.15
OCT	2.91	2.95	3.04	3.91	3.75	3.34	3.39	2.87	3.22	3.05	3.01
NOV	2.68	2.67	2.44	2.51	3.17	2.16	2.56	2.02	2.64	2.56	2.52
DEC	2.11	1.92	1.97	1.75	2.84	1.80	2.08	1.58	2.17	2.14	2.25
ANNUAL	37.69	35.71	36.39	35.71	43.04	34.37	36.55	33.01	35.83	36.24	35.41

NOTE: Source materials for climatological data in this report are:

(1) for precipitation, temperature, snowfall and evaporation data;

a) Climatography of the U.S., NOAA (National Oceanic and Atmospheric Administration) publications #11-10 and #86-10 (summaries of data for 1931 - 1960).

b) Climatological Data for Indiana, NOAA (Data for 1961 - 1970).

(2) for flood and drought information;

Water Resources Data for Indiana, U.S. Geological Survey.

FIGURE III-1 MEAN MONTHLY PRECIPITATION
Kankakee River Basin, Indiana

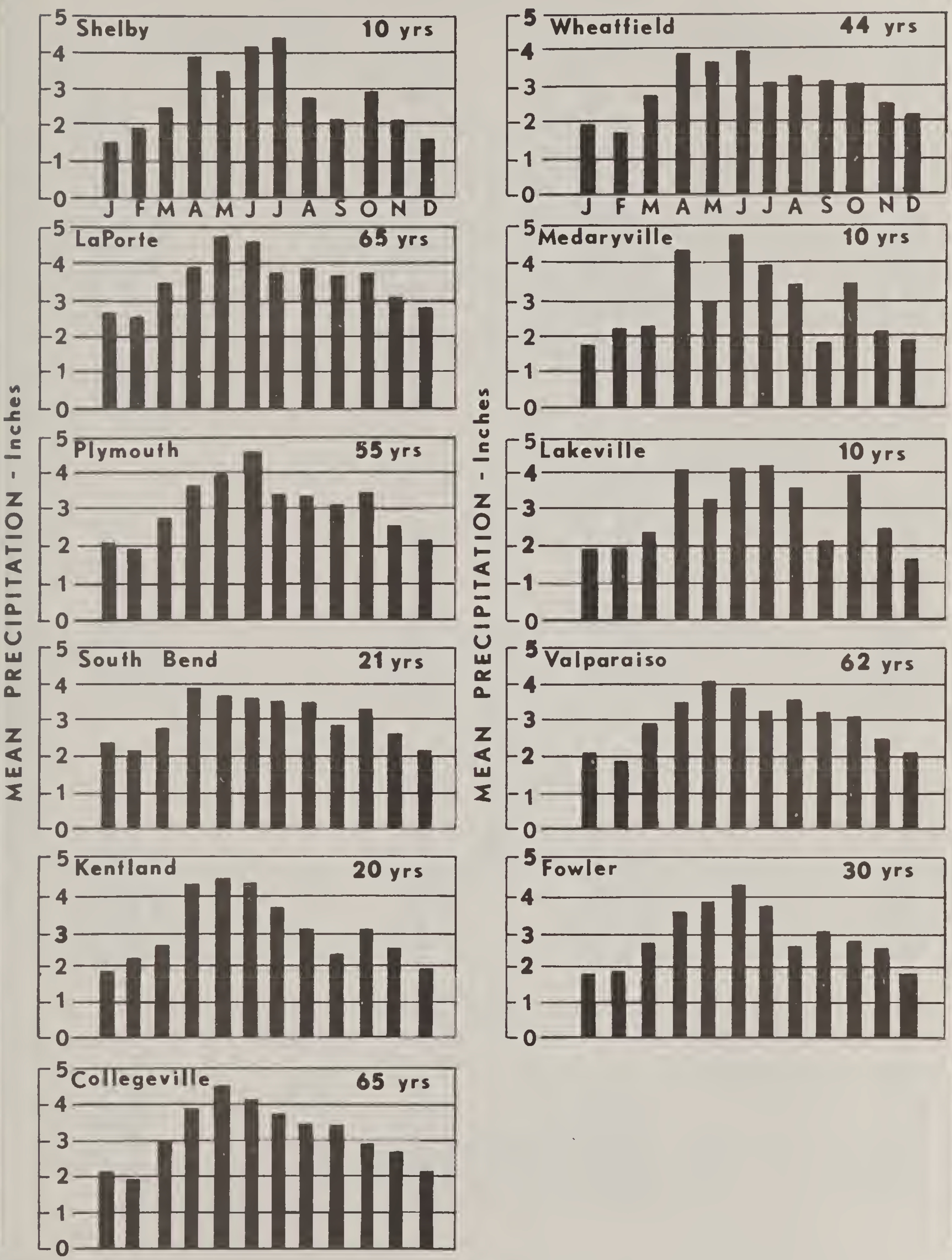


TABLE III - 5: MEAN MONTHLY AND ANNUAL SNOWFALL - INCHES FOR YEARS OF RECORD INDICATED

Kankakee River Basin, Indiana

MONTH	COLLEGEVILLE 58 Yr.	FOWLER 18 Yr.	KENTLAND 10 Yr.	LAPORTE 62 Yr.	PLYMOUTH 49 Yr.	SOUTH BEND 22 Yr.	VALPARAISO 54 Yr.	WHEATFIELD 40 Yr.
JAN	6.7	5.0	5.5	13.5	7.8	13.8	8.8	6.9
FEB	5.3	4.4	6.0	13.1	6.2	12.1	8.0	5.1
MAR	4.0	2.2	2.5	9.4	5.3	7.7	7.0	4.9
APRIL	.7	.5	.1	1.8	1.0	1.3	1.5	1.0
MAY	.1	.0	T	.3	.4	.1	.3	.1
JUNE	.0	.0	.0	T	T	.0	.0	T
JULY	.0	.0	.0	T	.0	T	.0	.0
AUG	.0	.0	.0	T	T	T	.0	.0
SEPT	T 1/	T	T	.1	.0	.1	T	.1
OCT	.2	T	T	.7	.6	.4	.4	.2
NOV	1.8	2.8	2.7	6.4	2.2	7.1	3.7	3.1
DEC	6.3	4.8	5.1	15.3	7.3	13.6	8.8	6.2
MEAN ANNUAL	25.1	19.7	21.9	60.6	30.8	56.2	38.5	27.6

1/ T indicates Trace Amount

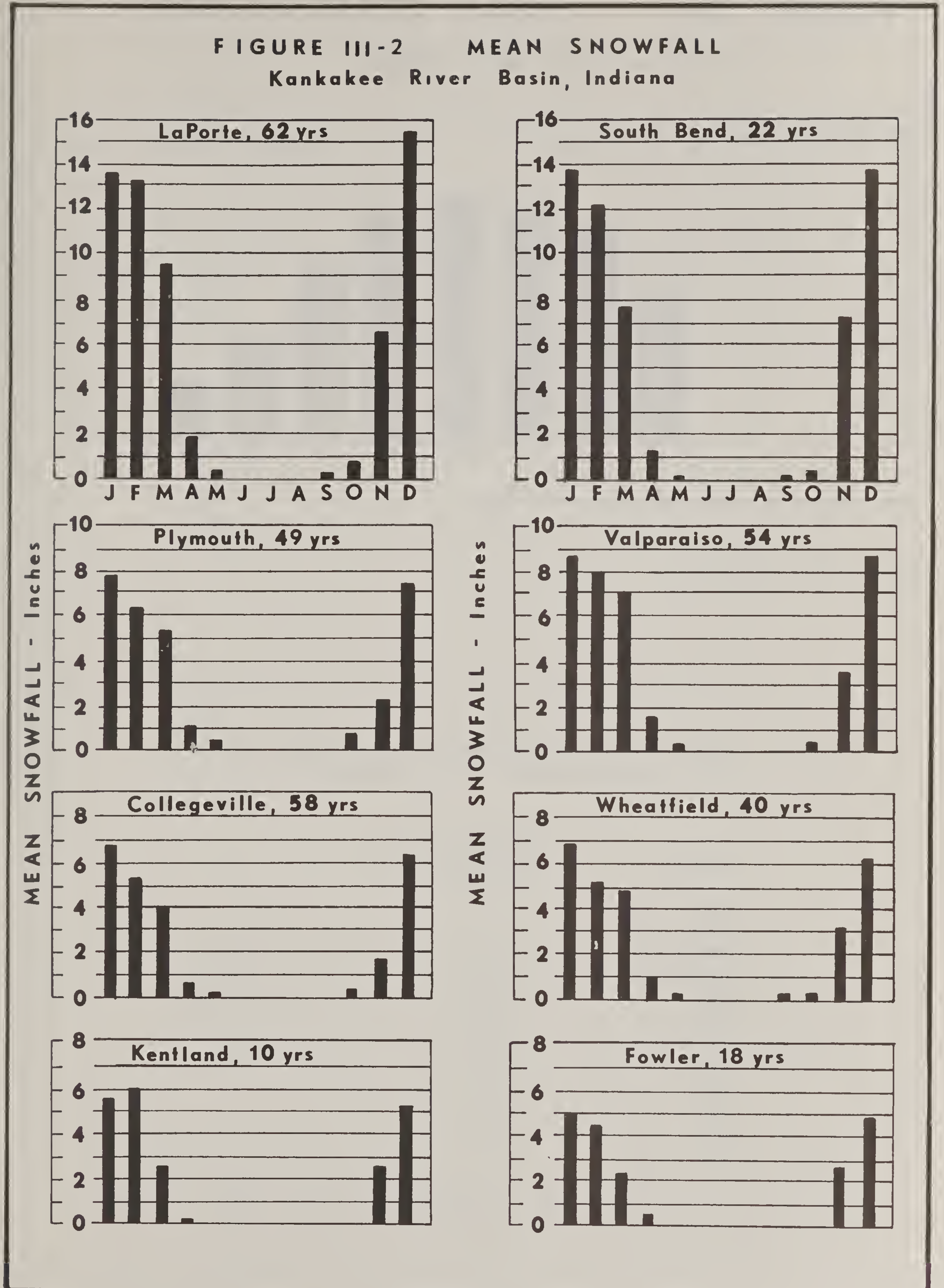
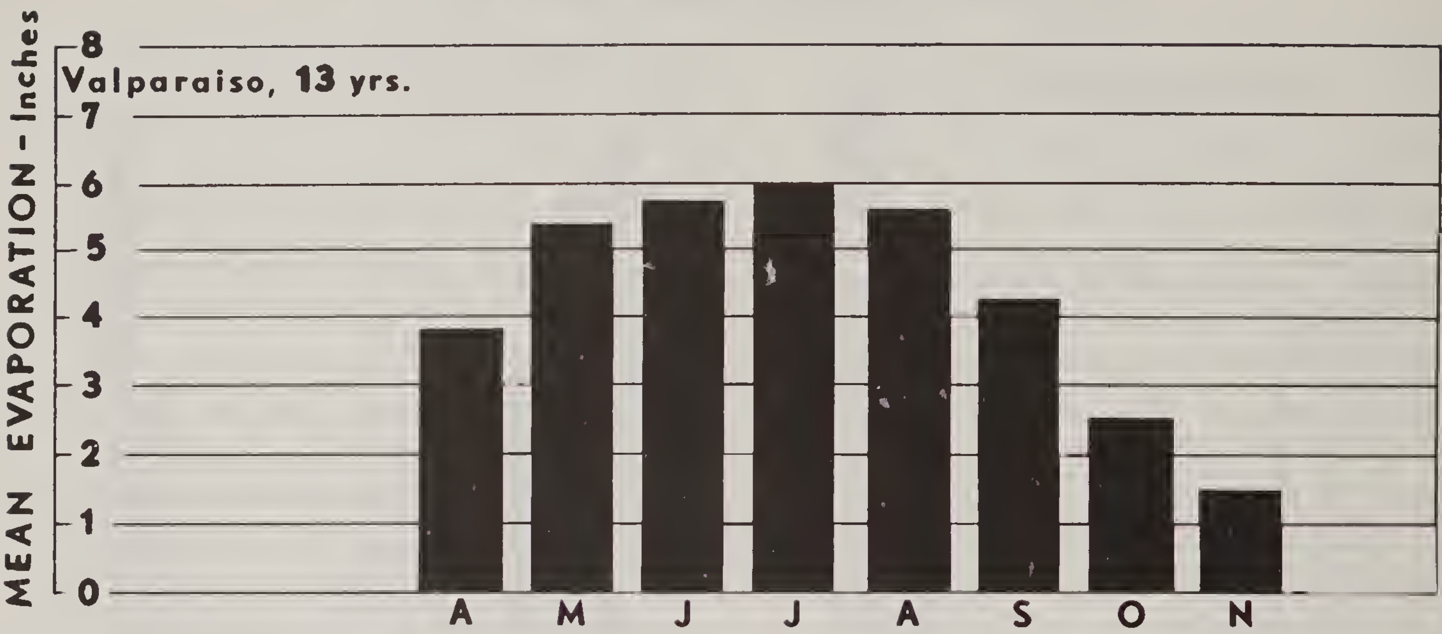


FIGURE III-2 MEAN SNOWFALL
Kankakee River Basin, Indiana
LaPorte, 62 yrs
South Bend, 22 yrs
Plymouth, 49 yrs
Valparaiso, 54 yrs
Collegeville, 58 yrs
Wheatfield, 40 yrs
Kentland, 10 yrs
Fowler, 18 yrs
MEAN SNOWFALL - Inches
J F M A M J J A S O N D
0
2
4
6
8
10
12
14
16

FIGURE III-3 MEAN EVAPORATION

Kankakee River Basin, Indiana



No record for Jan., Feb., Mar., and Dec.

Class A Pan Evaporation

TABLE III - 6 MEAN EVAPORATION - INCHES
Kankakee River Basin, Indiana

MONTH	VALPARAISO GAGE 13 YEARS RECORD
JAN	--
FEB	--
MARCH	--
APRIL	3.90
NAY	5.32
JUNE	5.80
JULY	6.00
AUG	5.67
SEPT	4.16
OCT	2.54
NOV	1.50
DEC	--

TABLE III - 7: MEAN DAILY TEMPERATURES BY MONTH - DEGREES FAHRENHEIT
Kankakee River Basin, Indiana

	PLYMOUTH 53 Yr.		COLLEGEVILLE 59 Yr.		FOWLER 28 Yr.		WHEATFIELD 29 Yr.		LAPORTE 61 Yr.	
MONTH	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN
JAN	33.9	17.4	34.8	17.3	35.7	19.1	33.8	17.0	32.6	16.2
FEB	36.3	19.2	37.3	19.0	38.3	21.3	36.9	18.1	34.2	17.6
MARCH	46.7	27.2	48.8	28.5	48.0	28.6	47.2	26.0	45.5	26.8
APRIL	60.5	37.6	61.8	38.4	62.3	39.3	60.4	36.7	58.6	36.7
MAY	71.4	47.2	73.6	48.6	73.4	49.7	70.3	46.6	70.8	46.9
JUNE	81.2	57.0	83.3	57.7	83.5	60.0	82.3	57.1	80.8	56.6
JULY	85.8	61.1	87.7	62.0	87.8	63.8	87.2	60.2	86.0	61.6
AUGUST	84.2	59.3	85.5	60.2	85.7	62.1	85.1	58.5	83.6	59.7
SEPT	77.2	52.4	78.5	53.0	79.2	54.6	78.1	50.6	76.5	52.5
OCT	65.1	41.4	66.8	42.1	67.5	43.8	66.0	40.2	64.5	41.7
NOV	48.9	30.8	50.7	30.8	49.7	31.3	49.0	29.0	48.3	30.6
DEC	36.6	21.1	37.5	20.8	37.5	21.6	36.4	19.3	35.4	20.1
ANNUAL	60.7	39.3	62.2	39.9	62.4	41.3	61.1	38.3	59.7	38.9

flow characteristics and the depletion of water in storage from both ground-water aquifers and surface reservoirs. Table III-6 and Figure III-3 show the recorded Class A pan evaporation for April through November for the Valparaiso station.

(4) Temperature

Mean Annual. The average annual temperature is about 50 degrees Fahrenheit. Mean daily maximum and minimum temperatures are about 61 degrees and 40 degrees Fahrenheit, respectively. See Table III-7.

Monthly Distribution. The average monthly temperature for January is about 26 degrees Fahrenheit and for July, 75 degrees Fahrenheit. Graphical presentation of mean monthly temperature data is shown on Figure III-4.

Extremes. The lowest recorded temperature was minus 27 degrees Fahrenheit, and the highest was 116 degrees Fahrenheit, both occurring at the Collegeville station.

(5) Droughts

Dry periods may be caused by the lack of precipitation, excessive evaporation caused by high temperature and dry winds or untimely distribution of a normally sufficient amount of rain. The soils in the basin vary in their ability to withstand droughts. Droughts are usually local in nature and crops seldom ruined, but an economic loss may occur due to reduced yields. Evaporation and transpiration often exceed precipitation in the growing season. Table III-8 shows dry periods of record that have affected the Kankakee Basin.

(6) Floods

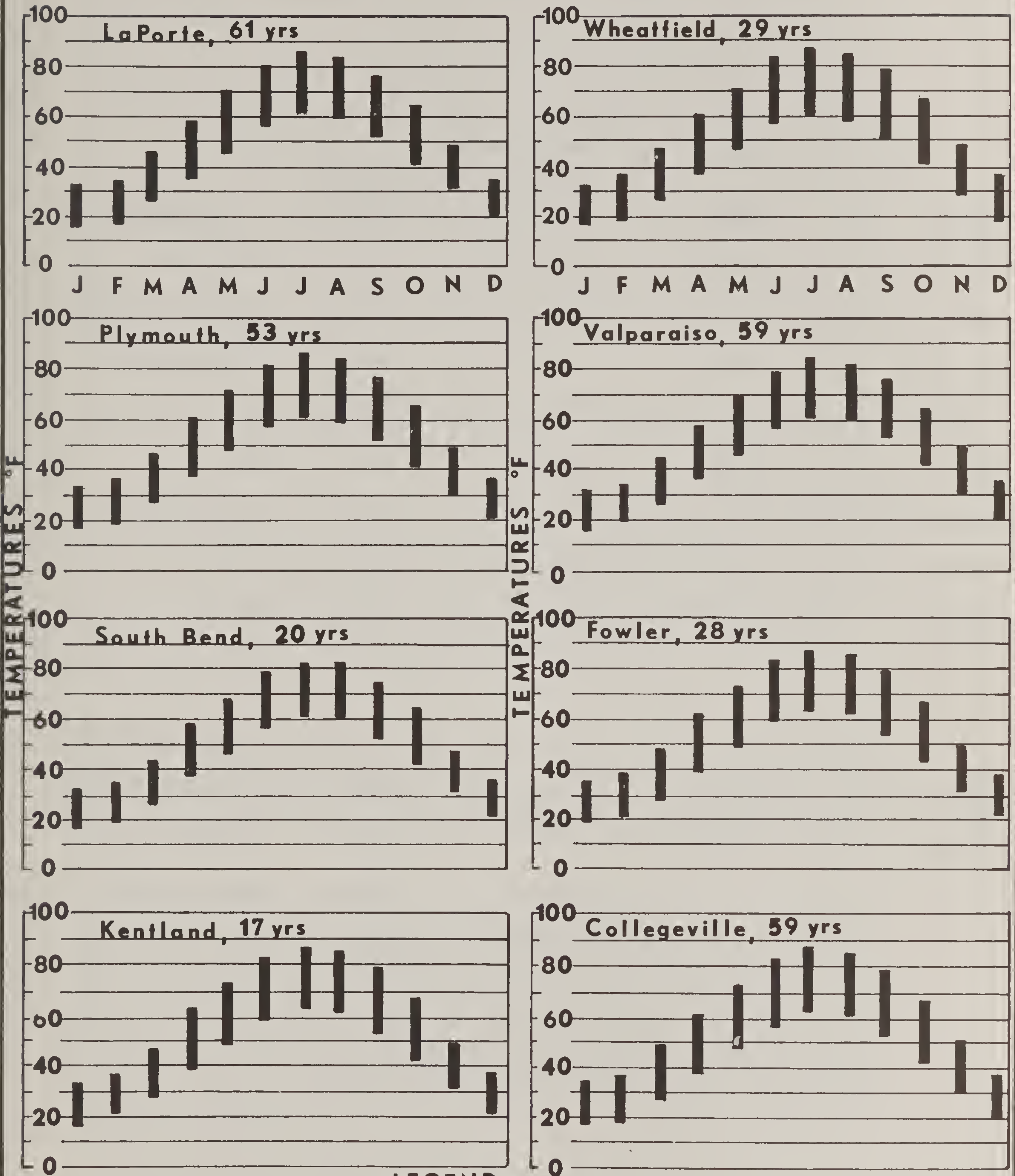
Flooding in the Kankakee Basin is usually caused by long duration rainfall occurring in the fall, winter, or spring. Streams with relatively small drainage areas may flood in any season as a result of intense thunderstorm activity. Large floods have occurred at one or more locations in the Basin during December 1927, April 1950, July 1953, October 1954, June 1958, February 1959, February 1968 and January 1973.

4. Land Use and Related Plant Community

The predominant land use in the Basin is cropland which comprises approximately 76 percent of the land area. The row crops of corn and soybeans are predominant comprising an estimated 84 percent of cropland. Rotation hay and pasture, primarily alfalfa and red clover in combination with various grasses such as bromegrass, orchardgrass, fescue and timothy, are grown on approximately 5 percent of the cropland. Small grains, primarily wheat and oats, are grown on 9 percent of the cropland.

FIGURE III-4 MEAN MONTHLY TEMPERATURES

Kankakee River Basin, Indiana



LEGEND

MEAN DAILY MAXIMUM

MEAN DAILY MINIMUM

TABLE III - 8 : DROUGHTS
Kankakee River Basin, Indiana

	ANNUAL PRECIPITATION-INCHES			
STATION	MEAN	RECORD LOW	DROUGHT YEAR	DRY MONTHS
MEDARYVILLE	34.37	23.01	1956	SEPT, OCT
WHEATFIELD	35.41	25.27	1956	JAN,MARCH,SEPT,OCT
LAKEVILLE	35.71	27.10	1956	JAN, SEPT, OCT
LA PORTE	43.04	32.66	1956	SEPT, OCT
SHELBY	33.01	27.07	1956	SEPT, OCT
COLLEGEVILLE	37.69	31.15	1956	JAN, SEPT, OCT
VALPARAISO	36.24	29.97	1948	JULY-OCT
PLYMOUTH	36.55	30.75	1953	SEPT-DEC
				IROQUOIS BASIN
FOWLER	35.71	26.03	1956	JAN,MARCH,SEPT,OCT
KENTLAND	36.39	27.09	1956	JAN,SEPT,OCT
"		27.30	1944	JULY,OCT,NOV
"		27.70	1940	JULY, SEPT

Approximately 142.2 thousand acres (8%) of the total 1,766.9 thousand acres of land in the Basin is forest land. Ninety-two percent of this is classified as commercial forest land, i.e., land which is either producing or capable of producing crops of industrial wood and is not withdrawn from timber utilization. The remaining 8 percent is classified as non-commercial forest land, i.e., either unsuitable for timber growing because of low productivity or because of legal reservations for recreation or other non-timber uses. With the exception of a small acreage of planted pines occurring in small, scattered tracts throughout the Basin, the primary forest type is Northern Hardwoods. The principal tree species associations, in order of their magnitude of occurrences, are oak-hickory, maple-beech-birch, elm-ash-cottonwood, oak-gum-cypress, aspen-birch, and pine. The stand size classes are 51 percent sawtimber, 23 percent seedlings and saplings, 23 percent poletimber, and 3 percent unstocked.

Grazing damage of varying intensity is occurring on approximately 14 percent of the commercial forest land. Damages from excessive sheet or gully erosion, wildlife, and insects and disease are minor.

Approximately 7 percent of the Basin is grassland. The unimproved pastures consist primarily of bluegrass. Improved pastures are established generally as combinations of legumes and grasses which tend to become primarily grasses as the sod becomes more dense and the legumes are crowded out. The more common grasses and legumes include alfalfa, birdsfoot trefoil, ladino clover, red clover, Kentucky bluegrass, orchardgrass, reed canarygrass, smooth bromegrass, tall fescue and timothy.

Approximately nine percent of the Basin land area is in Other land use which includes farmland as well as rural non-farmland. Farmland includes farmsteads, farm roads, feed lots, ditch banks, fences and hedge rows. Other rural land in non-farm use includes residence lots, investment tracts, marshes not used for grazing, and similar areas.

A major portion of this Other land is in marshes and is described more fully in section III-A-7, "Kind and Location of Wetlands." Vegetation in the shallow marshes include grasses, sedges, smartweed, goldenrod, aster, cattail, and bur reed. Deep marsh vegetation consists mainly of yellow and white water lily, cattail, bullrushes, spikerushes, and various aquatic grasses. Dogwood, willow, bottonbush, blueberry, winterberry, and chokeberry comprise the primary vegetation in the shallow shrub swamps. Deep shrub swamp vegetation include bottonbush, blueberry, winterberry, chokeberry, dogwood and willow.

5. Surface Water Resources

a. Streams

The Kankakee River heads near South Bend, Indiana, and flows west-southwestward for about 100 miles to the vicinity of Kankakee, Illinois, where it is joined by the Iroquois River. It then flows northwestward for about 35 miles where it joins with the Des Plaines River to form the Illinois River. The Illinois River is a major tributary within the Upper Mississippi River Basin. Principal tributaries of the Kankakee River are the Iroquois River which drains 2,137 square miles (843 in Indiana) and the Yellow River which has a drainage area of 439 square miles, all in Indiana.

Total fall in the Kankakee River from its head to its mouth is about 220 feet. From its head downstream through the St. Joseph - LaPorte County line the gradient averages about two feet per mile. The average stream fall is slightly less than one foot per mile for 80 miles from this location to Momence, Illinois, where a prominent bedrock outcrop occurs in the channel. This rock tends to maintain the water at a high level upstream from Momence and into Indiana. Downstream of Momence the gradient averages two feet per mile except for a steeper reach in the vicinity of the Kankakee River State Park where the bed slope averages four feet per mile for a distance of ten miles. Flood plain characteristics also change at the vicinity of Momence. Whereas the upstream lands adjacent to the Kankakee River are nearly level for extended distances away from the stream, the downstream flood plain is confined to a more narrow, clearly defined entrenched valley. This feature becomes increasingly pronounced downstream of the city of Kankakee, Illinois.

There are two low-head dams on the Kankakee River, both in Illinois. The respective locations, Wilmington and Kankakee, are such that there is no effect upon the stream flow in Indiana. No channel modification projects have been carried out on the Illinois portion of the Kankakee River. The entire length of the Kankakee River in Indiana has been channelized. This work involved straightening and relocating most of the waterway. Major construction was completed at the time of World War I, and the stream remains in the same location today. Throughout the Indiana portion of the Kankakee River the channel is aligned in straight segments so that the river mileage is about one-third the old natural stream distance. Maintenance activities since the original construction have been confined to the upstream reaches leaving many miles of the river untouched for over 50 years.

The Iroquois River heads near Rensselaer, Indiana, from where it

flows west-southwestward 75 miles through Watseka, Illinois, thence in a northerly direction for 25 miles to its junction with the Kankakee River at Aroma Park, Illinois, about four miles southeast of Kankakee, Illinois. Total fall in the Iroquois River is about 100 feet for an overall average of one foot per mile. Actual bed slope, at a given reach may vary considerably from this average. For instance a rock outcrop near Chebanse, Illinois, maintains a nearly level pool for more than 20 miles upstream. Downstream of Chebanse, the gradient is much steeper than average. A minor flood plain entrenchment characteristic is common to the Iroquois River in Illinois with less entrenchment found with progression to the headwaters.

The Iroquois River remains in a natural condition upstream to the vicinity of Brook, Indiana. Upstream from Brook the channel has been straightened and enlarged. Since the original work was completed, early in the century, only irregular maintenance has been performed.

The Yellow River heads in southern St. Joseph County, Indiana, near the town of Wyatt. Total length of this stream is about 65 miles. This stream flows through the cities of Bremen, Plymouth, and Knox, Indiana, before discharging into the Kankakee River about 11 miles west of Knox.

Overall average gradient of the Yellow River is about two and one-half feet per mile. The eight mile reach upstream from Knox, Indiana, has the steepest gradient of about five feet per mile. The flood plain downstream of Knox is common with the Kankakee River flood plain. Beyond Knox, the flood plain is entrenched so that flood flows are usually contained within a width of only a few hundred feet.

Channel excavation from just upstream of Knox to the outlet was completed near the first of this century. The stream was straightened through this reach. From a few miles downstream of Bremen to the headwaters the channel was excavated. Maintenance has been intermittent on these reaches.

Most tributary streams to the Kankakee River in Indiana are manmade channels, particularly in the downstream reaches where they discharge into the River. The larger of these tributaries were of natural origin with outlets to the Kankakee marsh. Most of the extensive Kankakee valley alluvial plain is drained by excavated ditches.

An extensive stream gaging network in the Kankakee River Basin yields information regarding extreme flow, flow duration, volume-duration, and stage-discharge (See Plate 6, Hydrologic Data Network, for location of the stream gages).

b. Lakes

Several lakes are important features of this Basin. The largest lakes are Bass Lake at Bass Lake, Indiana, Ringneck Lake at Jasper-Pulaski State Fish and Wildlife area, and J. C. Murphy Lake at the Willow Slough State Fish and Wildlife area with each having a surface area of about 1,400 acres. Lakes ranging in size between 300 and 800 acres are Hudson Lake near the city of Hudson Lake, Pine Lake at LaPorte, Koontz Lake near the city of Koontz Lake, Lake of the Woods near Bremen, and Cedar Lake near the city of Cedar Lake. There are no intermediate size lakes between 800 and 1,400 acres. Altogether, there are approximately 50 lakes having more than 10 acres in surface area. The total combined surface area of the lakes is about 10,000 acres. The cumulative water surface area of all the lakes represents less than one percent of the Basin. Many of the lakes are of natural origin whereas others are formed by low dams. Most of the lakes in the Basin are of comparatively shallow depth.

Wildlife habitat is prevalent in the vicinity of the lakes. Wildlife habitat is enhanced by areas of marsh adjacent to some of the lakes. A few of the lakes have cabins and houses along the shoreline, but lake front living is not a principal use of the Basin lakes.

Regulatory authority for lake use and development is vested in the state and county governments. Efforts are being put forth to protect the natural environmental values of the lakes and adjacent land areas. However, water quality, excessive eutrophication, or other problems do exist at some lakes.

c. Water Quality

The quality of a body of water is defined in terms of the physical, chemical, biological, and bacterialogical characteristics of the water and stream bed. These natural characteristics in turn are influenced by the geology and climate of the area, stream flows, and various types of water discharges. The significance of these characteristics and their variations depend on the water uses under consideration. At the present time, the State of Indiana does not maintain a water quality sampling station on the Kankakee River or its tributaries. However, during the period 1957 - 1970, the Indiana Water Quality Monitoring Program included stations on the Yellow River at Knox, the Kankakee River at Shelby, and the Iroquois River at Foresman. A summary of the water quality data from these 3 stations for the period 1968 through 1970 is presented in Table III-9. These data indicate generally good quality water for present uses. The hardness values indicate moderately hard to hard water, and the turbidity values are high at times, especially at the Iroquois River station. Since 1970, 10

TABLE III - 9 SUMMARY OF WATER QUALITY DATA - 1968, 1969, 1970
Kankakee River Basin, Indiana

Station	Constituent or Characteristic									
	pH. laboratory	Specific Conductance (micromhos/cm	Alkalinity as $CaCO_3$	Chlorides as Cl	Nitrates as N	Hardness as $CaCO_3$	Sustended Matter	Phosphates as PO_4	BOD	Dissolved Oxygen	Turbidity (Jackson Units)
			.... Milligrams per liter........								
Kankakee River at Shelby											
Minimum	6.7	450	140	10	0.2	224	1	0.1	1.0	6.2	5
Maximum	8.0	940	216	34	4.8	392	96	2.1	30.0	13.0	90
Average	7.4	623	185	14	1.5	307	24	0.4	2.9	8.9	17
Yellow River at Knox											
Minimum	6.8	350	98	15	0.3	180	5	0.1	1.0	5.0	5
Maximum	8.1	700	238	36	8.1	354	89	2.7	6.1	14.8	90
Average	7.5	559	197	17	2.9	291	23	0.5	2.2	9.5	18
Iroquois River at Foresman											
Minimum	6.7	240	48	10	0.3	134	8	0.1	1.0	4.1	5
Maximum	8.2	840	250	43	9.0	394	370	1.9	6.7	16.0	370
Average	7.5	651	193	23	3.4	332	55	0.5	2.4	8.6	53

Source: Indiana Water Quality, 1968, 1969, 1970, Indiana State Board of Health and Stream Pollution Control Board.

pollution surveys have been conducted within the Basin. In addition, two biological or limnological surveys have been performed on lakes and streams within the Basin. These data will be evaluated by the Indiana State Board of Health as part of a study leading to a "Water Quality Management Plan" for the Basin. The above described study is tentatively scheduled for completion in November 1978. Because of this pending "Water Quality Management Plan", a special analysis of these water quality data was not attempted for this cooperative study.

6. Ground-water Resources

Adequate supplies of ground-water exist in the Kankakee Basin. The following discussion considers the availability, levels, thickness of aquifers, vertical profiles, bedrock topography, relation to surface streams, and water quality.

All public water supply and essentially all other water uses in the Basin are met from ground water. High yielding wells are readily obtained at most locations.

a. Ground-water Availability

Ground water in the Kankakee River Basin is available from two primary sources which are the unconsolidated glacial drift aquifers and the limestone/dolomite bedrock aquifers. The glacial aquifers exceed the bedrock aquifers in importance as a ground water source on a basin wide scale. Regionally, the limestone/dolomite aquifer takes on a more important role, especially in areas where glacial aquifers are limited or nonexistent. Plate 8 depicts the general ground-water availability in the Basin. Such availability is directly dependent upon the geohydrologic conditions that exist in each region; therefore, certain physical factors control the amount of water that can be obtained from an aquifer. Plate 8 describes some of these factors and also gives an estimate of the maximum yield that could be expected from a well in each region.

The major source of ground water in the Kankakee River Basin is the Kankakee Aquifer. This aquifer extends from the Illinois state line in the west to the Michigan state line in the north and encompasses 50 percent of the Basin area (refer to Plate 8). Geologically, the aquifer is composed of glacial outwash material which forms a broad, relatively flat plain covered with morainal materials in some areas. The majority of this aquifer is unconfined with some regions having artesian conditions due to overlaying confining till deposits. The outwash material is sand and gravel which grades from mostly sand in the western reaches of the Basin to sand and gravel in the northern and eastern reaches. The thickness of the aquifer also increases in this same west to north and east pattern. Vertical profiles of the Basin shown on Plate 7 (Geologic Cross Sections), demonstrate the thickening of the aquifer. Yields of ground-

water from this aquifer are largest where the aquifer is thickest and coursest.

Another major aquifer system is in the eastern portion of the Basin (pink area on Plate 8). The aquifers of this region are composed of sand and gravel which are intermixed with glacial tills and, although they are the result of the same sequence of glacial events as the Kankakee Aquifer, they are not an extension of the Kankakee Aquifer.

The last major "province" of ground water availability is basically that portion of the Iroquois River Sub-basin that lies within Indiana. The Kankakee Aquifer penetrates only a portion of this region (see Plate 8). Geohydrologically, the region is quite different from the rest of the Kankakee River Basin. The limestone/dolomite bedrock aquifer is important in this region since it comprises a large portion of the available ground water sources for the area. The aquifers in the Rensselaer Buried Valley (refer to the Bedrock Topography Map on Plate 9) are possibly the best single source of ground water for future development in the region.

The water availabilities shown on Plate 8 are intended as a guide to the general capabilities of aquifers in large regions. Additional information would be needed for any individual well development. Such information can be obtained from the Indiana Department of Natural Resources, Division of Water. This type of information is in the form of published reports of ground water in counties, atlases of ground water in various counties, water well records submitted to the state by water well drillers, and personal knowledge of water availability in the state. Water well drillers and contractors also are helpful with this type of information for regions with which they are familiar.

b. Ground-water Level

Since ground water, by definition, occurs underground it is often important to know at what depth, or elevation above sea level ground water may be encountered. This information is not only important for water well development but it is also useful for excavations, surface drainage, and agricultural purposes. Of primary interest here is the effect that ground water levels have on ground-water production.

A broad, general statement can be made about ground-water levels to the effect that such levels follow the general contours of the land surface. This statement holds in the case of water table (non-confining) conditions in an aquifer. An aquifer under these conditions is recharged by precipitation which percolates downward due to gravity. This same aquifer will naturally discharge into streams and lakes and also will lose water by evapotranspiration. Thus, in nature, ground water

(in table conditions) flows from higher elevations towards lower elevations much like surficial run-off, but at a much slower rate of movement.

The ground water movement situation can change, somewhat, where semi-artesian or artesian conditions exist in an aquifer. Where these conditions exist, the water in the aquifer is confined by an overlying, relatively impervious layer of material, possibly clay or shale. Such a confining layer retards movement of water, and once the aquifer is saturated with water, this same confining layer causes hydrostatic pressure (or head) to build in the aquifer. Therefore, a water well drilled into the artesian aquifer will show a water level in the well that is above the saturated zone of the aquifer. The actual water level of the artesian aquifer may be above, below, or the same as the water level of an unconfined aquifer above it. In the Kankakee River Basin, it has been found that, on a regional basis, ground-water levels vary only slightly where aquifer conditions change. Such aquifer changes include variations from unconfined to artesian sand and gravels; from semi-artesian sand and gravel which are inter-bedded with tills to limestone/ dolomite bedrock aquifers that are overlain by tills. The Ground Water Level Map shown on Plate 10, when compared with the Water Availability Map on Plate 8, will show that various ground water environments have little effect on regional water level trends.

There are notable exceptions to the above conditions; however, these exceptions are local in nature. One such exception is the perched water table where a retarding layer or bed holds an amount of ground water above the normal regional water level. Another possibility occurs in deep buried valley aquifers which are under confined conditions and are also under tremendous vertical head, or pressure, due to their depth of burial. The water levels of the buried valley aquifers are usually different than those of the local water table aquifer. Such a condition exists in the Kingsbury Buried Valley (see Bedrock Topography Map on Plate 9) at the Kingsbury Fish and Wildlife Area near LaPorte. Several anomalous water level highs or mounds and water level lows or depressions have been recorded in the northern portions of the Basin. The cause of these mounds and depressions can, at present, be put only into a realm of speculation.

It must be emphasized that the map on Plate 10 depicts regional ground water levels. Should major ground-water development be contemplated for a given area, the knowledge of general ground-water levels for that area can be helpful in designing the facility and also in determining if the local ground-water level that is encountered is normal for that location.

c. Saturated Thickness of the Kankakee Aquifer

Another important physical feature of any aquifer is it's saturated thickness which is that portion of the aquifer that contains water. Naturally, in an artesian type aquifer, the entire aquifer is filled with water continuously. In an unconfined water-table aquifer, the saturated zone can vary due to seasonal fluctuations. Such seasonal fluctuations of the water table surface, which is the top of the saturated zone, are small in the Kankakee Aquifer.

The saturated thickness of the Kankakee Aquifer is shown on Plate 11. The physical relationship of the saturated thickness and the land surface cannot be read from this map. This map will indicate broad areas where thicker sections of the aquifer are present. Such thicker sections, in general, indicate areas where potentially higher yields of water are possible due to the greater available drawdown in a well. The saturated thickness map was drawn for the Kankakee Aquifer since it is the major source of ground water in the Basin. It will be noted that the Kankakee Aquifer does not encompass the entire Basin area, thus some portions of the Basin do not have an indicated saturated thickness. The aquifers of these areas are more complex geologically than the Kankakee Aquifer and they do not lend themselves readily to a regional saturated thickness analysis. The Water Availability Map (Plate 8) will aid in evaluating these other regions, with reference to saturated thickness since the saturated thickness is one of the parameters which affects the yield of water to a well. A rule of thumb to follow would be that in areas where higher yields to wells are indicated, the permeability, transmissivity, and saturated thickness are greater than in areas where lower yields are indicated. This general approach will be satisfactory on a regional basis. Of course, more detailed study is necessary for individual areas.

d. Vertical Profiles

A vertical profile of a geologic environment is an important tool for understanding the geology and hydrology of an area. A profile is merely a map, on a vertical scale, of what exists below ground, just as a road map shows transportation routes on a horizontal scale. Such a profile will show the relationship between the geologic conditions in the map and the profile.

Vertical profiles, shown of Plate 7, depict geologic conditions that exist in the Kankakee River Basin. It must be emphasized that the vertical scale on the profiles is exaggerated 200 times greater than the horizontal scale thus the vertical relations can be better seen. The profiles are arranged with the southern-most one at the bottom of the page to the northern-most one at the top of the page (see map insert). The Kankakee Aquifer thickens towards the northern part of the Basin and the

Valparaiso Moraine trends over the Kankakee Aquifer in the northwest part of the Basin. The bedrock is quite deep and composed of shale throughout most of the Basin. Where limestone/dolomite is the initial bedrock encountered, it is often used as a water source. In the eastern portion of the Basin, the glacial aquifers are interbedded with glacial tills and the Kankakee Aquifer becomes non-existent.

These vertical profiles are valuable tools in describing and understanding the three dimensional geologic world of the Kankakee River Basin.

e. Bedrock Topography

The bedrock surface, or topography, is the erosional features that were carved into the bedrock eons ago when that bedrock was exposed to the elements of the weather. The geology and elevation of the bedrock as well as precipitation patterns were key factors in the development of the drainage patterns which can be seen on a bedrock topography map.

An understanding of the topography of the bedrock in the Kankakee River Basin is important with respect to potential ground-water development. The map on Plate 9 shows the bedrock surface in the Basin and particular note should be made of the large buried valleys, especially the Kingsbury Buried Valley in the north central part of the Basin and the Rensselaer Buried Valley in the southern part of the Basin. These buried valleys are important for the potential ground water that might be developed from them; however, the significance of each valley to the region through which it trends is different.

The Kingsbury Buried Valley contains thick sections of permeable, artesian, sand and gravel aquifers; however, the valley exists in an area where large supplies of ground water are available in shallower aquifers, principally the Kankakee Aquifer; thus, very little effort has been made to utilize these buried valley aquifers. The water supply for the Kingsbury Fish Hatchery does tap these deeper (160 to 180 feet) aquifers and this pumpage is apparently the only use of them. The real potential for the Kingsbury Buried Valley aquifers is when production from shallower aquifers becomes limited, should such occur. Exploration drilling will be necessary to define the actual buried valley aquifer; therefore, the location of the valley indicated on Plate 9 should be used as a general guide to the areas where the valley exists.

The Rensselaer Buried Valley, in the Iroquois River Sub-basin, is of major importance to the ground-water development of that region. This buried valley contains sand and gravel aquifers that are considerably more prolific in water production than most of the limestone/dolomite aquifers that surround them

(refer to Plate 8, Ground-water Availability Map). The aquifers in this buried valley are currently used to some extent, and their full potential is, as yet, undeveloped. Their potential yield of water does not approach that of the Kankakee Aquifer or the Kingsbury Buried Valley aquifers, but these aquifers are possibly the best source of ground water in the Iroquois River Sub-basin. Again, exploration drilling is recommended for individual site development so that the aquifer itself may be delineated. The bedrock topography map (Plate 9) should be used to locate the general area of the buried valley.

The two buried valleys described above are the major topographic features of the bedrock surface in the Kankakee River Basin. The remainder of the bedrock surface in the Basin comprises a relatively featureless, rolling plain where drainage patterns are less pronounced than those of the great valleys. Such terrain in general, does little in helping to supply ground water. Locally, some beds of sand and gravel, which may lie in depressions in the bedrock, can be exploited for ground water; however, these aquifers are not large enough, nor prolific enough, to be major sources of ground water.

f. Surface - Ground Water Inter-Relationship

The relationship between surface and ground water in the Kankakee River Basin is not well understood; however, it is apparent from stream flow data and the available information compiled on the ground-water hydrology that these systems are intimately connected and that most of the streams receive a substantial portion of their flow from ground-water reservoirs. In some areas of the Basin ground-water contribution to stream flow probably exceeds the 50 percent flow duration.

Low flow characteristics of the streams are also a direct reflection of the adjacent aquifer systems. The Kankakee River main stem has substantial low flow. Iroquois River low flow is comparatively much less, a consequence of the different adjacent acquifer.

g. Ground Water Quality

Data on ground water quality are limited to the chemical analysis performed on raw (natural) and treated water of the twenty-eight municipal drinking water supply systems in the Basin. Each of these communities utilizes ground water as its source of supply. Selected chemical characteristics of these sources, as listed in Table III-10, were compiled from the records of the Indiana State Board of Health.

This Table has been arranged to indicate the drinking water quality with relation to certain elements listed in "U. S. Public Health Service Drinking Water Standards - 1962". These include

the basic chemicals that determine water quality with respect to palatability and appearance.

Table III-10 lists the communities, with line "A" denoting raw water quality and the range of the test results for the various characteristics and chemicals. Line "B" indicates the range of these same chemicals for the treated water. No treatment of the water supply (other than chlorination) is practices where Line "B" is blank. This Table indicates that ground water is generally moderately hard with iron and manganese present in most sources. The presence of such chemicals is not necessarily harmful to humans, but locally may cause some dissatisfaction with such untreated water supplies.

Ground water resources available to all public water supplies in the Kankakee River Basin appear to be adequate for their present and certainly for near-term future requirements. While the quality may not be completely desirable or meet the Standards, it is possible to correct deficiencies with treatment and continue to utilize this resource. Rural ground water sources are found to contain most of the same chemical characteristics found in the public supplies.

7. Kind and Location of Wetlands

A survey was made by the Division of Fish and Wildlife, Indiana Department of Natural Resources in the late fifties and early sixties to inventory the wetlands and to serve as a base for comparison in future years. Another survey was made during 1970, 1971, and 1972. Both surveys considered wetlands to be natural or man-made areas in which the water table was permanently at or above the surface of the land.

Each area was classified according to the criteria in the United States Department of the Interior publication "Wetlands of the United States", Fish and Wildlife Circular 39. Briefly, a description of the wetland types used is:

Type 3. Shallow Marsh. An area where the soil is normally waterlogged during the growing season. It is often covered with as much as six inches of water. Typical vegetation consists of grasses, sedges, smartweed, goldenrod, and aster. In wetter areas, cattail and bur reed are common.

Type 4. Deep Marsh. Areas where the soil is covered with 6 inches to 3 feet of water during the growing season. The vegetation is primarily yellow and white water lilies, cattails, bulrushes, spikerushes, and various aquatic grasses.

TABLE III - 10: QUALITY OF GROUND WATER
Kankakee River Basin, Indiana

Communities		pH	Alkalinity as $CaCO_3$	Chlorides as Cl (250)	Fluorides as F (1.0)	Magnesium as Mg	Manganese as Mn (0.05)	Nitrates as N (10)	Sodium as Na	Sulfates as SO_4 (250)	Hardness as $CaCO_3$	Color Units (15)	Turbidity Units (5)	Iron as Fe (0.3)	Calcium as Ca	Potassium as K
Argos	A 1/	7.2-7.5	309-314	4-10	0.2-0.4	28	0.03-0.05	0-0.6	7-12	17-33	317-346	<5	5	1.7-2.2	81-91	1
	B 2/	7.3-8.3	298-304	8-17	0.3	10-30	0.02-0.04	0.1	16-110	11-30	105-326	5	0.2-3.0	0.03-0.7	26-82	1
Bremen	A	7.3-7.7	278-324	4-11	0.5-0.7	24-32	<0.02-0.1	<0.1-1.6	18-30	0-9	255-285	5	1-40	0.9-5.8	58-63	1-2
	B	7.0-8.1	280-299	7	0.6		<0.02				260-262		0.2-0.5	<0.03-0.2		
Brook	A	7.2-7.8	282-306	1-3	0.4	22-25	0-0.08	0.1-0.7	29-36	0-2	224-268	<5	0.4-10	1.1	53-67	2
	B	7.3-8.4	290-302	5	0.4-0.8	23	0-0.8	<0.1	32-34		234-264	<5	0.1-9.0	1.0-1.1	56-57	2
Earl Park	A	7.5-7.9	294-298	1-2	0.3-0.4	21-32	<0.05	0.2-0.5	47-55	26	220-224	<5	2-5	0.8	37-53	3-5
	B															
Fowler	A	7.5	304	8	0.4-0.6	34	0.04	<0.1	18	60	338		20	1.9	80	2
	B	7.5			0.5		0.02						0.02	<0.03		
Goodland	A	7.2-7.6	398-405	90-91	1.2-1.3	13-14	<0.02	<0.1-0.2	200-212	22-27	104-108	<5	0.1	<0.05-0.2	19-22	8-10
	B	7.2-8.2	390-404	103-105	1.1-1.4	13-23	<0.02	<0.1	190-215	14-15	103-152	<5	<0.1-0.8	<0.05-0.1	22	10
Hamlet	A	8.0	90-94	<1-1	0.1	6-8	0.03-0.05	<0.1	4	17	102-104	0	0.05-0.2	<0.04-0.1	28-31	<1
	B															
Hebron	A	7.0-8.3	374-392	4-11	0.1-0.2	46-50	0.04-0.08	<0.1-0.2	13-18	68-75	441-450	<5	15-60	1.9-2.6	98-100	2
	B	7.5-8.5	372-388	11-12	0.1-0.2	9-10	<0.02	0.1	185-188	70-78	76-100	<5	0.2-1.0	0.03-0.2	16	1
Kentland	A	7.4-8.1	276-286	<1-2	0.5-0.7	14-20	<0.02-0.03	0.2-0.7	67-71	<1-2	133-144	<5	0.08-10.0	<0.05-0.4	23-31	2-4
	B															
Kingsford Heights	A	7.4-7.9	118-148	5-8	<0.1	14-15	0.05-0.07	0.7-0.8	4-6	45-54	178-190	<5	0.3-2.0	0.1-0.2	48-51	1
	B	7.4-8.0	120-133	7	0.1	14	<0.02-0.05	1.3	4-6	46	180-182	<5	0.05-0.3	<0.03-0.1	49	2
Knox	A	7.4-7.7	124-152	3-5	0.1-0.2	8-9	0.05-0.1	<0.1	3-11	11-19	135-160	<5	0.3-3.0	1.4-2.5	42-49	<1
	B	7.2-7.8	122		0.1		0.04-0.06				134		0.02-0.1	0.03-0.08		
Kouts	A	7.2-8.0	102-130	16-22	0.1-1.4	12-18	0.08-0.2	0.1-0.2	10-17	75-86	196-214	<5	0.5-5.0	0.4-0.6	53-59	3-4
	B															
LaCrosse	A	7.0-7.4	299-332	179-265	0.1-0.2	36-39	0.5-0.6	0.4-0.6	110-150	100-103	424-436	5	35	4.8-4.9	110	6-28
	B	7.7-7.8	308-328	270	0.1	6	0.11-0.2		330		82-118		3	0.3-0.8	22	
Lakeville	A	7.8-7.9	240-256	2-9	0.2-0.3	29-35	0.06-0.1	<0.1	4-9	54-80	290-338	0	0.7	0.3-0.9	68-78	1
	B															

1/ Raw Water (A)
2/ Finished Water (B)
Source: Public Water Supply Data from Indiana State Board of Health, 1964-1973.
Figures in parentheses refer to limits described in U.S. Public Health Service Water Standards, 1962.
All columns except pH, color and turbidity are expressed in milligrams per liter.

TABLE III - 10: QUALITY OF GROUND WATER - (con't)
Kankakee River Basin, Indiana

Communities		pH	Alkalinity as $CaCO_3$	Chlorides as Cl (250)	Fluorides as F (1.0)	Magnesium as Mg	Manganese as Mn (0.05)	Nitrates as N (10)	Sodium as Na	Sulfates as SO_4 (250)	Hardness as $CaCO_3$	Color Units (15)	Turbidity Units (5)	Iron as Fe (0.3)	Calcium as Ca	Potassium as K
LaPorte	A 1/	8.0	192-222	9-23	0.1		0.02-0.17	<0.1-0.2	6-10	56-100	268-316		10-25	1.4-3.0	66-89	<1-2
	B 2/	8.0			0.7-0.9	23-25	<0.02		5-10				0.01-0.09	<0.03		
Lowell	A	7.4-8.2	358-388	69-79	4.1-4.5	7-9	<0.02	0-0.1	190-220	39-47	57-78	<5	0.2-1.0	<0.05-0.3	11-17	6-7
	B	7.5-7.8	338-378	105-113	4.1-4.5	8	<0.02	<0.1-0.2	200-228	25-35	60-74	0	0.1-0.3	<0.05-0.1	11-16	6-7
Morocco	A	7.0-7.4	162-172	25-36	0.1-1.3	17-26	0.2-0.38	0.2	14-20	64-135	240-320	<5	8-20	0.8-1.9	69-86	2-3
	B	7.5-7.8	158-186	27-38	0.2-1.3	6-7	<0.02-0.11	0.1-0.3	110-124	66-135	72-102	<5	0.4	0.02-0.1	20-30	2
New Carlisle	A	7.7-8.2	198-232	2-4	<0.1-2.0	23-26	0-0.05	0-0.2	3-7	2-53	202-286	<5-10	2-10	0.6-1.7	43-73	<1-2
	B	7.6-7.8	232-236	2-8	0.7-1.0	21-26	0.02-0.04	<0.1	5-55	36	270-288	<5	7-10	0.8-0.9	72-73	<1-3
North Judson	A	7.1-7.7	124-130	6-10	0.7-0.8	8-9	0.03-0.11	<0.1-0.6	16-20	0-1	96-109	<5	0.1-1.0	<0.03-0.2	25-28	1-2
	B															
North Liberty	A	7.2-8.0	266-296	4-8	0.1-0.2	28-33	<0.03-0.3	0.08-0.2	7-9	21-36	284-320	<5	0.06-1.0	0.1-0.5	66-74	1-2
	B															
Plymouth	A	7.5-7.8	280-308	<1-4	0-0.2	27-33	0.25-0.4	0-0.4	3-4	17-30	312-322	0-<5	0.3-20	0.2-1.9	74-84	<1-1
	B	7.4-7.7	283-288	2-8	1.1-1.2	27-30	0.17-0.28	0.1-0.2	3-4	28-34	320-328	0-<5	0.06-5.0	<0.03-0.2	81-84	<1-1
Remington	A	7.2-8.0	336-352	<1-15	0.3-0.5	30-34	<0.02-0.03	<0.1-0.4	18-20	6-34	314-362	<5	1-15	0.6-2.0	76-89	2-4
	B	7.2-7.9	338-356	15	0.5-0.7	31	<0.02-0.04	<0.1-0.3	20-22	28	335-348		6	1.2-2.6	88	3
Rensselaer	A	7.5-7.6	330-342	12-17	0.1-0.3	36-38	0-<0.05	0.1-0.9	27-28	53-71	372-375	<5	0.1-0.3	0.01-0.07	88-89	2-3
	B	7.5-7.8	318-320	22-27	1.0	15-21	0	0-<0.1	130-144	66-68	112-140	0-<5	0.1-0.3	0.03-0.07	20-22	6-9
Schneider	A	7.5-8.2	302	29-37	0.7-0.9	30	0.02	0.3-0.6	60-62	56-68	264-276	0	0.3-4.0	<0.1-0.7	56-61	5
	B	7.1	294	41	0.7	26	<0.02	0.8	71	48	252			1.3	58	6
South Bend	A	7.0-7.8	216-308	6-150	0-0.8	24-40	<0.02-0.31	<0.1-4.8	3-81	27-260	250-618	<5-5	<0.1-2.0	<0.05-2.4	61-181	1-4
	B	7.0-8.0	171-244	10-22	0.1-1.0	24-29	0.01-0.07	<0.1	4-8	35-48	221-302	<5	0.1-6.0	<0.03-0.6	64-73	1-2
Walkerton	A	7.9	236	17	0	17	0.02	0.7	40	45	210	<5	0.3	<0.05	55	3
	B	8.1	232	17	1.0	4	0.01	0.7	120	45	42	<5	0.2	<0.05	10	1
Westville	A	7.4-7.9	191-296	2-12	0.1-0.2	24-34	0.05-0.12	<0.1	3-8	43-74	269-342			1.0-4.5	66-85	1
	B															

1/ Raw Water (A)
2/ Finished Water (B)
Source: Public Water Supply Data from Indiana State Board of Health, 1964-1973
Figures in parentheses refer to limits described in U.S. Public Health Service Water Standards, 1962
All columns except pH, color and turbidity are expressed in milligrams per liter.

Type 5. Open Water. Water in this type is of variable depth. The vegetation, if any, is predominately submergent.

Type 6 wetlands are shrub swamps. The Department felt this type was important enough in Indiana to divide into two sub-classifications. These are the 6^3 or shallow shrub swamp and 6^4 or deep shrub swamp which are defined as:

Type 6^3. Shallow Shrub Swamp. Soil is normally water-logged during the growing seasons; often as much as 6 inches of standing water is present. The principal vegetation is dogwood and willow with lesser amounts of buttonbush, blueberry, winterberry, and chokeberry.

Type 6^4. Deep Shrub Swamp. This is similar to the 6^3 except water is from 6 inches to 3 feet deep during the growing season. The predominant vegetation is usually buttonbush or, less commonly, a mixture of blueberry, winterberry, and chokeberry. Dogwood and willow can also occur.

Table III-11 is a summary of the number and acres of wetlands in the Kankakee Economic Area by type. About 50 percent of all wetlands in the area are open water areas (Type 5). Another type is the shallow marsh (Type 3), with about 25 percent. The Type 3 area not only has a high value for the wetland oriented wildlife, but as the driest of the wetlands we consider, it often provides a critically needed habitat for more upland species.

Type 3 wetland is generally a more stable habitat than, for example, are the pheasant's normal haunts. If, for some reason, such as fall plowing, fence row clearing, heavy snows and some other reasons, the pheasant's usual home is unavailable, the shallow marsh and its good rank vegetation often supplies an emergency habitat.

The remainder of the Basin wetlands are more or less equally distributed among the Types 4, 6^3 and 6^4.

Table III-12 shows the size distribution for the various wetland types in the Economic Area. The Area has numerous small farm pond fisheries and a good distribution of larger lakes. With the possible exception of Type 3, however, the size distribution of other wetland types is not evenly distributed. Other than Type 5, only a few wetlands have more than 20 acres; the majority have less than 5 acres.

The prime concentration of wetland areas are actually quite local (Plate 12). In Lake County, two concentrations of wetlands are evident. One is on the Indiana-Illinois line directly west of Crown Point and the second is centered about 6 or 7 miles southwest of Crown Point, with Cedar Lake near its northern edge. Another area

TABLE III - 11. NUMBER AND ACREAGE OF WETLANDS BY CLASSIFICATION TYPE
Kankakee River Basin (Economic Area), Indiana

Wetland Type	Number of Wetlands	Total Acreage	Average Size in Acres	Percent of the Total Number of Wetlands in the Area	Percent of the Total Wetland Acreage in the Area
3	860	6,992	8	27	22
4	312	3,117	10	10	10
5	1,384	18,609	13	44	57
6^3	276	1,674	6	9	5
6^4	304	1,952	6	10	6
Totals	3,136	32,344	10	100	100

TABLE III - 12. SIZE DISTRIBUTION OF WETLANDS BY CLASSIFICATION TYPE
Kankakee River Basin (Economic Area), Indiana

Acreage Class	3	4	5	6^3	6^4	Total	Percent of Total
0.0-0.9	0	0	488	0	0	488	16
1.0-4.9	516	196	692	164	216	1,784	57
5.0-9.9	140	48	92	80	40	400	13
10.0-19.9	128	28	32	16	24	228	7
20.0-49.9	60	32	24	16	24	156	5
50.0-99.9	12	4	20	0	0	36	1
100 & over	4	4	36	0	0	44	1
Totals	860	312	1,384	276	304	3,136	100

partly in Lake County but is centered in Porter County about 10 miles north of the Kankakee River. Jasper County has significant wetland concentrations only on the existing Jasper-Pulaski Fish and Wildlife Area. Starke County wetlands are primarily on Fish and Wildlife property at the Kankakee Area. That portion of LaPorte County in the Basin has two wetland concentration areas. One is centered near the City of LaPorte and the other borders the central one-third of the LaPorte-St. Joseph County line in the vicinity of the Fish Lakes. St. Joseph County has two small wetland areas, one in the extreme northwest corner, and the other is in the extreme south central portion near the Marshall County line. Marshall County wetlands border the Yellow River southwest of Plymouth. In addition to these ten primary concentrations, smaller but still highly significant groupings and individual wetlands are scattered throughout the entire Basin. LaPorte County is the most significant area for wetlands in the Basin with about one-third of all areas both in number and total acreage. LaPorte's neighboring County of Porter is second with about one-fourth of all wetlands. Marshall and Lake Counties have large acreages of open water.

Roughly one-half of all wetlands are open water areas, one quarter are shallow marshes and the remainder more or less equally divided among the other three wetland types. The Basin has relatively few large wetland areas of any type other than open water.

B. Economic Data

The smallest reporting unit for some of the economic data utilized in this study is the county boundary delineation. Therefore, it was assumed that if a portion of the county were located within the hydrologic boundary of the Basin, the entire county would be included in the economic analysis. These data for the entire counties of Benton, Jasper, Lake, LaPorte, Marshall, Newton, Porter, St. Joseph, and Starke are included. If data for the entire nine-county area is included in the analysis, this area hereinafter will be referred to as the Economic Area. Unless otherwise stated, all data in this section relates to the Economic Area.

1. Land Ownership

Most farm operators are owner operators, as shown in Table III-13. The percentage of farmers owning all of their land has averaged about 55 percent for the 1959 to 1969 time period, whereas, 63 percent of the farm operators were classified as full owners in the State. Farm operators classified as part-owners has remained fairly constant with approximately 25 percent. The most significant trend has been the decrease in the number of manager-operated farms. Tenant farming has also decreased from 2,890 farmers in 1959 to only 1,720 in 1969

2. Farm Enterprises - Number, Size, and Types

Technological changes and the influence of urban expansion have

Table III - 13: FARM TENURE, BY COUNTY, 1969
Kankakee River Basin (Economic Area), Indiana

County	All Farm Operators	Full Owners	Part Owners	All Tenants
Benton	833	247	276	310
Jasper	1,194	572	355	267
Lake	878	469	213	196
LaPorte	1,371	806	390	175
Marshall	1,711	1,192	368	151
Newton	647	240	186	221
Porter	946	517	262	167
Starke	754	440	224	90
St. Joseph	1,364	906	315	143
TOTAL	9,698	5,389	2,589	1,720

Table III - 14: FARM NUMBERS, AVERAGE SIZE AND DISTRIBUTION BY SIZE GROUPS 1959-1969 1/ Kankakee River Basin(Economic Area), Indiana

	Units	1959	1964	1969
Farms	Number	12,315	10,222	9,698
Average Size	Acres	174.0	201.1	212.1
Size Distribution			Percent	
Less than 49 Acres		25	23	22
50 - 499 Acres		71	69	69
500 Acres and Larger		4	8	9

1/ U. S. Census of Agriculture

resulted in major changes in farm numbers and land use patterns. More efficient equipment, improved varieties of seed, increased use of fertilizers and chemicals, and improved management have allowed the individual producer to expand production by being able to operate a larger acreage in addition to producing more per acre. A decline in farm numbers and resulting increase in farm size is one of the most significant aspects of the Basin agriculture.

The number of farm operating units declined from 12,315 in 1959 to 9,698 in 1969 for a loss of 2,617 farms or 21 percent as shown in Table III-14. In contrast, the number of farms in the State decreased 26 percent during the same time period. The reduction in farm numbers has reflected a corresponding increase in the size of the remaining farms. Census data reveal that the number of farms having 500 or more acres has increased from 545 to 877 in the 1959-1969 period. In the same period the number of farms having 50 to 499 acres decreased from 8,744 to 6,720 or 2,024 fewer operating units. Farms under 50 acres in size have decreased in numbers from 3,061 in 1959 to 2,101 in 1969. The trend to fewer and larger farming units has resulted in average farm size in the Kankakee Economic Area increasing from 174 acres in 1959 to over 212 acres in 1969

Cash grain farms are the most predominant type of farming operation, accounting for over 60 percent of the total commercial farms. Livestock production, other than dairy, is concentrated in Marshall, Starke, and St. Joseph Counties, accounting for over 20 percent of the remaining farms; however, dairy farms decreased by more than 46 percent in number from the 1959 to 1969 time period. In addition, the number of farms classified as general decreased from 551 in 1959 to only 209 in 1969. Fourteen percent of the cash grain and vegetable farms in the State of Indiana are located in the Economic Area.

3. Crops and Yields

The Basin is located primarily in the Kankakee grain and pasture type of farming area 1/. The Iroquois River portion is mainly in the western cash grain area. Cash grain farming provides the major source of farm income with the remainder coming primarily from the sale of mixed livestock. This rather diversified agricultural economy results in numerous crops being grown. Corn, which is primarily harvested for grain (with some silage), soybeans, wheat, hay (alfalfa and clover-grass mixtures), and oats are the primary crops grown, accounting for approximately 97 percent of the cropland acreage.

1/ Purdue University, Agr. Experiment Station, A map of Indiana Soils (Indiana Type of Farming Areas).

The major crop grown in the Economic Area is corn, which accounts for about 49 percent 1/ of the crop acreage. Corn yields during the period 1954 - 1970 ranged from 52 bushels per acre in 1955 to 99 bushels in 1969 2/.

Soybeans, currently the second most important crop, have shown tremendous increases in acreage during the past 15-20 years. The acreage of soybeans increased from about 300,000 acres in 1954 to more than 450,000 acres in 1969. Soybean yields during the 1954-1970 period ranged from 21.3 bushels per acre in 1955 to 33.4 bushels in 1968.

Wheat is the third largest crop grown, although the acreage has declined from more than 150,000 acres in 1954 to 87,000 acres in 1969; a decrease of more than 40 percent. Wheat yield during this period have ranged from 28.5 bushels per acre in both 1957 and 1959 to 41.2 bushels per acre in 1966 to 1969.

Hay crops constitute the fourth largest crop, despite a decline of nearly 61 percent from 152,000 acres in 1954 to slightly more than 60,000 acres in 1969. Alfalfa hay and clover-timothy hay make up about 60 and 25 percent, respectively, of the hay grown. Average yields have ranged from 1.7 tons in 1955 to 3.0 tons in 1968.

Oats is the fifth most important crop grown in terms of acreage, and except for wheat,it is the only significant small grain grown in the Basin. The acreage of oats has decreased from more than 175,000 acres in 1954 to slightly more than 26,000 acres in 1969. Yields during this period ranged from 40 bushels per acre in 1954 to 65 bushels in 1968.

Other crops with significant acreages include 9,800 acres of vegetables, 4,500 acres of potatoes, 4,000 acres of grass silage, and 2,000 acres of popcorn. Except for the decreasing acreage of grass silage, these acreages have been rather constant throughout the past 15 years.

1/ U. S. Dept. of Commerce, Bureau of the Census, Census of Agriculture, 1969.

2/ U. S. Dept. of Agriculture, Statistical Reporting Service Purdue Univ. Agric. Exp. Station, Ind. Crop & Livestock Statistics, Annual Crop Summary, 1954-1970.

4. Land Values

The average value of land and buildings in the Economic Area was $481 per acre in 1969 1/ as compared to $232 in 1954. This amounts to an increase of 107 percent over the 15-year period, and shows land values have been increasing at the rate of approximately 7 percent per year during the period from 1954 to 1969.

Comparable figures for the State of Indiana show an increase from $194 per acre in 1954 to $406 per acre in 1969. This indicates that land values have been increasing at a rate which approximates that of the state as a whole.

Land values in flood plain areas vary greatly due mainly to location and flood hazard. Flood plain land values vary from $300 to $800 2/ per acre in agricultural areas, with the largest variation due mainly to flood frequency, land use, and soils. The inventory data cited above show average land values for the Basin estimated at $475 per acre, which correlates closely with the $481 value in the Census of Agriculture.

Land values in urban and urbanizing areas are extremely high, specifically in northern Lake, Porter, and LaPorte Counties and near South Bend in St. Joseph County. In these areas the demand for land for residential, industrial, and commercial development is strong, and this demand has resulted in high values for land with such development potential.

5. Accessibility to Roads and Markets

Accessibility to roads and markets are generally adequate to meet the needs of farm and non-farm population of the Basin. Major cities within close proximity of the Basin are the Gary, Hammond, East Chicago, and South Bend, Indiana, metropolitan areas. Other nearby cities include Elkhart and Michigan City, Indiana. Transportation routes have been developed to, and between, the major population centers in addition to secondary transportation routes for the rural sectors. The development of the transportation network has resulted in the expansion of a highly productive agricultural and industrial sector.

Marketing facilities in the Basin consist of local livestock auctions, grain elevators, and livestock buying stations. Livestock producers have the additional advantage of being located near the Chicago central livestock market. Marketing facilities are generally adequate; however, in recent years a shortage of box cars has resulted in some transportation problem for grain.

1/ U.S. Dept. of Commerce, Bureau of the Census, 1969 Census of Agriculture

2/ Source: Soil Conservation Service field inventory data.

6. Socio-economic Conditions

The Economic Area was originally subdivided according to the rectangular survey system which established townships containing 36 or less square miles. The township was therefore the smallest unit of rural government and formed the basis for the establishment of school districts. More recently consolidation has led to the merger of some township and small town schools into county school systems.

Churches have been important since establishment in the early social structure of the Area. They were usually established soon after settlement and represent predominant faiths of the early settlers.

The major town in each county was usually designated as the county seat and became the business and cultural center of the county. Industrial and residential development generally was drawn to these communities.

The railroads and improved transportation facilities helped some communities to grow and expand more rapidly than others. These factors have also lessened the ties of the essentially close knit social patterns which have been common throughout rural communities in the past.

C. Fish and Wildlife Resources

A riparian habitat and utilization survey of the Kankakee River Basin to determine fishing and hunting utilization, wildlife production, and vegetative characteristics was made in two segments. The tributaries of the Kankakee River in Indiana were studied during the summer of 1971 which included the Yellow River and its tributaries but excluded the Iroquois River which flows into Illinois before reaching the Kankakee. The Iroquois and its tributaries, the second segment, were surveyed in 1972. The survey involved the streams and ditches delineated on the Habitat Maps (Plates 13 and 14).

The survey disclosed that 25 tributaries of the Kankakee River in Indiana support extensive fishing pressure. Of these 25, six are in LaPorte County, five in Jasper, four are in Starke, three each in St. Joseph and Newton Counties and two each in Lake, Porter, and Marshall Counties. Other tributaries having wildlife importance were also surveyed. Twelve tributaries of the Iroquois River were surveyed. Eight of these are in Jasper County and four in Newton County. On all these tributaries, fishing is limited to the lower reaches.

The survey shows that there is not a single stream in this Basin that has not been partially or wholly reconstructed. Only four streams, three in LaPorte County and one in Jasper County, have segments in natural conditions.

A wide variety of wildlife species exist in the Kankakee Basin. Of the 52 mammal species and 336 species of birds recorded in recent years for Indiana, 45 and 263 respectively, have been seen in the Basin.

1. Habitat Quantity and Quality

The following discussion on Habitat Quantity and Quality is summarized from the results of the Riparian Habitat and Utilization survey.

Two Kankakee River tributaries of fishing importance were surveyed in Lake County. These were Singleton Ditch and West Creek, neither of which empties into the Kankakee in Indiana. Three other tributaries are of importance for wildlife but do not support significant fishing pressure. These are Brown Ditch, Cedar Creek, and Dike Ditch. Dike Ditch is not fished but is important because it provides heavy wood duck production.

Porter County features a number of ditches and creeks, but only Crooked Creek and Dahl (Cook) Ditch are fished extensively. Most of the others are small although many are several miles long and drain large areas. These generally support various forms of wildlife.

All ditches provide some fishing at the points where they outlet into the Kankakee, and nearly all support furbearing animals that are trapped to some extent, with trapping rights often purchased from the adjacent landowners. Some woodcock hunting is provided by marshy areas around Cobb Ditch in the southcentral portion of the county. Wolf Creek (Ludington Ditch) from Lake Eliza to its outlet in Cobb Ditch furnishes furbearing habitat, supporting beavers and mink. The area south of Dahl Ditch supports moderate populations of deer. Beavers exist in Grieger Ditch. Sandy Hook Ditch furnishes extensive fishing at its mouth in the Kankakee. Most of the ditches also support fair duck populations. Pheasant and quail hunting is generally good throughout the southern part of the county.

LaPorte County could probably be considered the most important fish and wildlife county in the Kankakee River Basin. The southwest corner of the county has extensive ditches that drain into the Kankakee; all of these are excellent muskrat streams, and six of these ditches receive moderate fishing pressure. It is also significant that LaPorte County has three streams--the Little Kankakee River, Union Mill Creek, and Kingsbury Creek--that possess natural sections. The Little Kankakee, Kingsbury Creek, and Slocum Ditch have all been stocked with trout in the past. The Little Kankakee, along with Crooked Creek in Porter County and Geyer Ditch and Potato Creek in St. Joseph County, is an extensively fished trout stream. Other streams surveyed in LaPorte were Pitner Ditch (Machler Ditch) and Hanna Arm Ditch.

Three tributaries of the Kankakee River were surveyed in St. Joseph County. These were Potato Creek, Geyer Ditch (Grapevine Creek), and Pine Creek. Another ditch, the Niespodziany, carries an ample flow of water for fish and wildlife, but discharge of pollution from the sewage works at New Carlisle has killed most of the game fish and forage species.

The survey disclosed no Kankakee River tributaries of significance for fishing in Marshall County with the exception of the Yellow River, which drains nearly all of the county and flows west through Starke County before emptying into the Kankakee. Wolf Creek is the only important fishing tributary of the Yellow River.

Four Kankakee River tributaries provide fishing in Starke County. These are Robbins Ditch, Yellow River, Kline Arm Ditch, and Lucas (Bogus) Ditch.

Five Kankakee River tributaries were surveyed in Jasper County, which is drained almost exclusively by the Iroquois River that flows through the southern half of the county. The Kankakee Tributaries are the Hodge, Davis, Brent, DeHaan, and Otis Ditches.

The tributaries of the Iroquois that were surveyed are Carpenter Creek, Howe Ditch with its tributaries, Bice and Keefe Ditches, Ryan Ditch, Curtis Ditch, Oliver Ditch and its tributary, and Davisson Ditch.

Newton County is drained predominantly by the Iroquois River. Kankakee River tributaries having fishing importance in the county are DeHaan Ditch, Knight Ditch, and Beaver Lake Ditch. Lawler Ditch, which flows into Beaver Lake Ditch, does not support fishing but is an excellent muskrat and wood duck stream. Best Ditch could be an excellent wildlife stream, particularly for puddle duck production; however, at least three landowners control water levels in the ditch and wildlife cannot depend on having a constant water supply.

The Iroquois River tributaries surveyed were Cole Ditch, Montgomery Ditch, Thompson Ditch, and Gushwa Ditch.

Public Access

Access to private land throughout the Basin generally varies from good to fair, providing permission is obtained from the landowners. Exceptions to this occur in Lake and the northern portions of Newton and Jasper Counties where access varies from fair to none and in Marshall County where access is excellent. Access to public lands is restricted by limited available public areas.

3. Endangered and Threatened Wildlife and Plants

Within the Basin and nationally, the Indiana bat, Southern bald eagle, and the Artic peregrine falcon are considered endangered. The greater prairie chicken and sandhill crane are listed as threatened nationally. The State of Indiana has listed six additional species as endangered in the state; however, the natural range of three of these species is believed to be restricted to central and southern Indiana which is outside the Kankakee River Basin. The remaining three species are the bobcat, badger and otter. Indiana also lists over 60 other nongame species of animals in need of management. To date no state or national list of threatened or endangered plants has been published. The Basin supported Indiana's last stronghold of 500 plus native prairie chickens during the past quarter century. The prairie plants required by this species have been depleted to the point that the prairie chicken has become extinct in Indiana.

For all of these animals, the public needs to be made aware of their precarious status. Preservation of their existing habitats and development of additional habitat areas are the major needs.

The threatened species means any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range. An endandered species or subspecies is one whose prospects of survival and reproduction are in immediate jeopardy nation-wide. Its peril may result from one or many causes - loss of habitat, or change in habitat, overexploitation, predation, competition, or disease. An endangered species must have help or extinction will probably follow.

D. Recreation Resources

1. Existing and Potential Resources

Recreation resources in the Kankakee Economic Area were inventoried to provide a basis for determining future needs and to determine which feature might influence people to visit a given recreation area or facility. Table III-15 is a summary of part of those resource features that attract recreational participants, and it also indicates areas where potential development may be considered.

Table III-16 includes a listing of some of the recreational opportunities in the Basin. This summary indicates the distribution and variety of recreational facilities and opportunities associated with camping and trailering.

2. Effect of Water Quality and Pollution

The Kankakee, Iroquois, and Yellow Rivers and their tributaries along with the lakes in the Basin offer a variety of recreational opportunities. Pollution from sewage treatment facilities has reduced the recreation potential of some of the streams. High population density on some of the lakes has created potential water quality problems. Where water quality, excessive eutrophication or other problems exist, aesthetic values and potential recreation activities are affected.

TABLE III - 15: RECREATIONAL FEATURES THAT ATTRACT RECREATIONAL PARTICIPANTS 1/
Kankakee River Basin (Economic Area), Indiana

County	Recreation	Fishing or Hunting	Forest Recreation	Historic & Memorial	Vacation Center	Natural Area	Spec. Sport	Play Area	Special Feature
	-------	-------	-------	-------	Number of Units	-------	-------	-------	-------
Benton	--	--	--	--	--	--	--	--	--
Jasper	9	2	--	--	--	--	7	12	1
Lake	111	16	--	--	6	1	54	275	7
LaPorte	20	9	1	1	1	2	24	54	7
Marshall	11	5	--	--	--	1	6	21	3
Newton	3	4	--	--	--	--	9	15	1
Porter	24	--	--	--	2	4	20	59	4
Starke	10	6	--	--	5	2	4	13	7
St. Joseph	41	8	--	--	--	9	29	105	4
Total	229	50	1	1	14	19	153	554	34

1/Source: Shaping the Future Indiana Department of Natural Resources, August 1969, Appendix I.

TABLE III - 16: RECREATIONAL OPPORTUNITIES ASSOCIATED WITH CAMPING AND TRAILERING 1/
Kankakee River Basin, Indiana

NAME	COUNTY	ACRES	TENT SPACES (No.)	TRAILER SPACES (No.)	ELECTRICITY	WATER	SEWER	PICNIC TABLES	RECREATION HALL	FLUSH TOILETS	SHOWERS	CAFE-SNACK BAR	STORE	SWIMMING POOL	OTHER SWIMMING	FISHING	BOATING	PLAYGROUND
Kingsbury State F&W Area	LaPorte	4,522	20	20	-	-	-	x	-	-	-	-	-	-	-	x	x	-
Jasper-Pulaski F&W Area	Jasper Pulaski	7,585	42	42	-	-	-	x	-	x	-	-	-	-	-	-	-	x
Kankakee	Starke & LaPorte	2,302	10	10	-	-	-	x	-	-	-	-	-	-	-	x	-	-
LaSalle	Lake & Newton	3,514	46	46	-	-	-	x	-	-	-	x	-	-	-	x	x	-
Willow Slough	Newton	9,200	50	50	-	-	-	x	-	x	x	x	-	-	-	x	x	-
Chuck Cain's Circle "C"	Jasper	30	395	395	x	x	x	x	x	x	x	x	x	-	x	x	x	x
Lake Eliza Resort	Porter	350	400	400	x	x	x	x	x	x	x	x	x	-	x	x	x	x
River Bend Campground	LaPorte	36	10	50	x	x	-	x	x	x	x	-	x	-	-	x	-	x
Triple "M" Campground	Jasper	80	20	20	x	x	-	x	x	x	x	-	x	-	x	-	-	x
Wildwood Campground	Starke	5	20	20	-	-	-	x	-	-	-	x	x	-	-	-	-	x
E-Z Camp	Starke	59	101	101	x	x	x	x	x	x	x	-	x	-	x	x	-	x
Duncan's Lake	Lake	40	-	100	x	-	-	x	x	x	x	x	x	-	-	x	-	x
Hickory Hill Campground	Starke	120	200	200	x	x	-	x	x	x	x	-	x	-	x	x	x	x
Candy Stripe Campsite	Porter	160	150	150	x	x	x	x	x	x	x	x	x	x	x	x	-	x
Mini-Mountain	St. Joseph	80	100	100	x	-	-	x	x	-	x	-	-	-	-	x	-	x
Timbertrail Campground	Marshall	70	30	30	x	x	-	-	-	-	-	-	-	-	x	x	-	x
Rockwell Shores	Lake	2	10	10	x	-	-	x	-	x	-	x	x	-	x	x	x	x
Beaver Ridge	St. Joseph	127	600	600	x	x	-	x	-	x	x	x	x	x	-	x	x	x
Remington Travel Land	Jasper	1	-	10	x	x	x	-	-	x	-	x	x	-	-	-	-	-
Lake Holiday	Jasper	137	30	211	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Shady Lane	Marshall	55	30	90	x	x	x	x	x	x	x	-	-	-	x	x	x	x
Bass Lake Beach	Starke	22	95	95	x	-	-	x	-	x	x	x	-	-	x	x	x	x
Pla-Mor Park	Marshall	7	25	75	x	x	-	x	x	x	x	x	x	x	x	x	-	x

1/ Source: Rand McNally's Campground and Trailer Park Guide, 1973

3. Public Accessibility and Facilities Provided

Utilization of recreational facilities will be more efficient when their distribution coincides with that of the population and its recreational interests. The mobility of people has made it possible for a recreation area to serve persons from outside the area as well as local residents. A summary of recreation areas and the scope of area they serve (Recreation Service Area), is shown in Table III-17. Development of facilities should be based on an examination of the demands, accessibility, and resources available. An inventory of developed recreational facilities in the Kankakee Economic Area is shown in Table III-18.

LaSalle, Willow Slough, Jasper-Pulaski, Kankakee, and Kingsbury State Fish and Wildlife Areas are all located in the Basin. These total in excess of 27,000 acres and offer such recreational opportunities as hunting, fishing, boating, hiking, and picnicking to the public.

Camping facilities are distributed throughout the Basin, and services range from nearly "primitive" to sophisticated amenities.

Several other types of outdoor recreation are available. Winter sports are possible over a moderately long season. Unorganized recreational opportunities are also found in visits to farm friends or by pleasure walks through privately-owned woodlands, with previous permission of the owner. Driving along wooded side roads reveals wildflowers, birds, and occasional wild animals in their natural settings.

4. Present Utilization

Utilization of most recreational facilities in the Kankakee Economic Area is at or near maximum. A visual examination of campgrounds, parks, picnic areas, and other facilities reveals the intensity of use and the overuse during peak use periods. Reservations are required for some recreational facilities. A review of existing recreational facilities and needs for the Economic Area indicates a shortage of facilities for picnicking, camping, golfing, bicycling, hiking, horseback riding, nature walks, hunting, boating, water skiing, canoeing, and other activities requiring playfields.

A camping survey conducted by the Department of Natural Resources indicated most complaints from campers were in regard to conditions found at the existing campgrounds. These conditions will exist when the carrying capacity is exceeded. Construction of parks has not kept up with demand, resulting in overcrowded conditions and detrimental effects to the existing facilities.

TABLE III - 17: INVENTORY OF PRESENT RECREATIONAL AREAS BY RECREATION SERVICE AREA, 1969 1/
Kankakee River Basin (Economic Area), Indiana

County	Recreation Service Area 2/							
	National or Multi-State	Regional	County	Community, City or Town	Neighbor-hood	Block Total Lots	Transient Roadside Parks	Total
	NUMBER							
Benton	--	1	4	10	1	--	--	16
Jasper	--	2	7	15	7	--	--	31
Lake	4	36	14	178	198	38	2	470
LaPorte	3	27	11	29	45	1	1	117
Marshall	--	12	8	12	14	1	--	47
Newton	1	5	7	19	--	--	--	32
Porter	6	13	8	70	15	--	1	113
Starke	--	24	7	7	7	--	2	47
St. Joseph	--	14	6	74	102	--	--	196
TOTAL	14	134	72	414	389	40	6	1,071

1/ Source: Shaping the Future, Indiana Department of Natural Resources, August 1969, Appendix I.

2/ Geographic Area that serves as the primary source of recreation users for a specific site.

TABLE III - 18: INVENTORY OF PRESENT RECREATIONAL FACILITY DEVELOPMENT, 1969 1/
Kankakee River Basin (Economic Area), Indiana

COUNTY	Picnic Facilities	Camping Facilities	Golf Course	Ski Slopes	Hunting	ROADS AND TRAILS			
	Areas	Areas	Courses	Developed	Areas	Foot	Bicycle	Horse	Canoe
	Number					Miles			
Benton	2	1	-	-	-	-	-	-	-
Jasper	7	2	1	-	1	7	-	-	-
Lake	93	6	20	-	2	1	-	15	-
LaPorte	28	8	6	4	3	8	-	8	-
Marshall	11	4	5	-	-	-	-	-	-
Newton	6	2	2	-	4	1	-	-	-
Porter	28	10	3	5	-	29	3	12	-
Starke	12	8	2	-	2	3	-	12	-
St. Joseph	35	1	10	2	2	6	-	-	-
TOTAL	222	42	49	11	14	55	3	47	-

1/ Source: Shaping the Future, Indiana Department of Natural Resources, August 1969, Appendix I.

TABLE III - 19: INVENTORY OF NATURAL AREAS [1]
Kankakee River Basin, Indiana

COUNTY	DESCRIPTION	MAP KEY NO. [2]	TYPE [3]	ACREAGE
Lake	MYSTERY MOUNDS. (SE 1/4, SW 1/4, Sec. 30, T34N, R9W). A raised peat formation surrounded by level agricultural ground. There are two elongated mounds. The area is owned by Henry Ruppenthal.	1	G	10
Newton	BEAVER LAKE NATURE PRESERVE. (SW 1/4, SW 1/4, Sec. 35, T31N, R9W, and Sec. 2, T30N, R9W). A 640 acre drained tract in this old lake basin. The area supports stands of switchgrass with mixtures of invading trees and shrubs. It is owned by Indiana Department of Natural Resources, Division of Fish and Wildlife.	2	T	640
Newton	TALL GRASS SAND PRAIRIE. (S 1/2, Sec. 14, T30N, R9W). This is an area with big bluestem and Indian Plume grass growing on sandy substrate having interspersed blowouts in the old Beaver Lake region. The area is owned by M. Karlock.	3	T	20
Newton	KENTLAND STRUCTURAL ANOMALY. (NW 1/4, Sec. 25, T27N, R9W). This area is located in an active quarry and is of geological significance as geologists do not have an explanation of the occurrence of Ordovician rock exposed at the surface in this part of the state. It is owned by Newton County Stone Company, Inc.	4	G	3
Jasper	PRAIRIE BORDER. (E 1/2, SE 1/4, Sec. 35, T32N, R5W & Pt. NE 1/4, Sec. 2). This is an area where prairie plants are interspersed with trees and shrubs on sand ridges and swales. Soils are outwash from fans and glacial channels in the Kankakee Basin. It is located in the Jasper-Pulaski Fish and Wildlife Area and is owned by the Indiana Department of Natural Resources, Division of Fish and Wildlife.	5	T	80
Jasper	BIRD MARSH. (NW 1/4 Sec. 11, T32N, R5W). This area is located within the refuge portion of the Jasper-Pulaski State Fish and Wildlife Area. It has shallow ponds bordered by low ground and is managed by the Indiana Department of Natural Resources, Division of Fish and Wildlife.	6	A	2
LaPorte	HASKELL'S PRAIRIE. (N 1/2, N 1/2, Sec. 17, T35N, R4W). A narrow strip of dry prairie vegetation bordering the Monon Railroad and extending for some distance on the railroad right-of-way in LaPorte County. It is owned by the Monon Railroad.	7	T	5
LaPorte	SHOEMAKER BOG. (NW 1/4, Sec. 33, T36N, R3W). The tract contains leatherleaf and sphagnum moss. Water reaches a depth of 3 feet. The area is owned by Perry Shoemaker and Lee M. Parsons.	8	A-T	50
LaPorte	MILL CREEK FEN. (SW 1/4, Sec. 34, SE 1/4, Sec. 33, T36N, R1W). This calcareous fen and adjoining second growth woods is reported as one of the few areas in Indiana containing hairy willow-herb and death camass. Ownership is unknown.	9	T	60
Starke	KOONTZ LAKE MARSH. (S 1/2, Sec. I, T34N, R1E). This area lies on the north side of the natural lake. It has not been studied in detail for determination of its natural features and priority rating. It is in multiple private ownership.	10	A-T	180
St. Joseph	BENDIX WOODS NATURE PRESERVE. (E 1/2, SW 1/4, Sec. 11, T37N, R1W). The old-growth beech-maple woods is part of Bendix Woods Gift Park and has marked nature trails. It is owned by St. Joseph County Department of Parks and Recreation.	11	T-Sc	27
St. Joseph	NEW OAK ROAD BOGS. (SE 1/4, NE 1/2, Sec. 19, T36N, R1E). The leather-leaf bog and adjacent low ground are located in the Potato Creek Recreation Area. It can be utilized as an area for nature appreciation and educational purposes. It is owned by Indiana Department of Natural Resources, Division of State Parks.	12	Sc-PR-T-A	40

1/ Includes nature preserves as indicated in description.
2/ Refer to Plate 15 - Environmental and Recreation Map.

3/ G -- Geological
A -- Aquatic Biological
T -- Terrestrial Biological
Sc -- School (Elementary and secondary level)
PR -- Preceptive Recreational

E. Natural, Historical, Archeological, and Scenic Areas

A natural area is described as an area of land and/or water, whether in public or private ownership, which either retains or has re-established its natural character (although it need not be undisturbed), has unusual flora or fauna, or has biotic, ecological, scenic, geologic or paleontological features of scientific or educational value. Nature preserves are similar areas which have been formally dedicated for full protection by action of the Indiana Natural Resources Commission.

In order to facilitate the establishment of priorities for the preservation of natural areas, inventories of these natural areas have been compiled. Table III-19 is a listing and short description of recognized natural areas, containing 1,179 acres, within the Kankakee River Basin. Other historic and scenic areas are identified on Plate 15 (Environmental and Recreation Map).

The Kankakee Basin is of importance archeologically because some of the earliest records for the American Indian involve groups in the southern Great Lakes area. Though present archeological data are incomplete, there is sufficient information available to emphasize the importance of the region. At the present time 793 sites within the Kankakee River Basin Economic Area are on record in the files of the Glenn A. Black Laboratory of Archaeology at Indiana University.

Benton is the only county in the Economic Area that does not have a recorded site. However, newspaper accounts suggest that prehistoric artifacts do occur with some frequency. Jasper County has twelve recorded sites which includes one mound group. A total of 141 accurately recorded sites are known in Lake County, occurring mostly in the terraces and sand-gravel ridges in the Kankakee River valley. These sites are predominantly Middle Woodland or Upper Mississippian, with at least a few Late Archaic in nature. There are seventeen sites in LaPorte County, most of which are Middle Woodland groups. Seventy-three sites have been recorded in Newton County. Most of these sites are located on sand islands formerly located in the Kankakee marshes. Porter County has 121 sites reported, with many of them being burial mounds. The greatest number of these are located in the Kankakee River valley. Most of the 88 sites reported in Starke County are located on the sandy spurs and dunes in the Yellow River valley. The St. Joseph River drainage is the location of most of the 24 recorded sites in St. Joseph County.

Marshall is the most adequately surveyed of any of the Kankakee drainage counties and may be taken as an adequate representation of what would be recorded in the other areas if an equal amount of time were devoted them. A total of 317 sites have been listed, located, and described. These range in time from the earliest known Paleo-Indian to Early Historic. Mounds were few in number and the great majority are small camps and villages.

F. Soil, Water and Plant Management

1. Land Use Trends

Land use changes throughout the Basin have been gradual and have not been the result of any sudden or drastic causative factors. During the past two decades there has been a gradual but continued decline in the acreage of land in farms 1/. From 1954 to 1969, land in farms in the Kankakee Economic Area decreased by slightly more than 5 percent, or an average of approximately 7,500 acres per year. Cropland acreage in 1969 was almost identical to that in 1954. Pasture acreage has declined as pressure for cropland and non-agricultural purposes has increased.

A decrease in forestland and increases in "Other Land" and "Urban and Built-up" lands also occurred. Much of this was a result of forestland going into non-agricultural development in and around the major growth centers of northern Lake, Porter, and LaPorte Counties. Maintenance of existing stands of trees as well as new plantings for aesthetics, screening, public use, etc. in urbanizing areas does add immeasurably to the overall quality of the environment of the urban dwellers as well as to the actual value of the lots being sold. People move from highly urbanized or industrialized areas to less developed rural areas for many reasons. The reasons are unique and personal to each individual contemplating a move to a rural, or less populated, area but such things as trees, shrubs, grass, space, clean air and quiet, seem to play a large part in the final decision of just where to locate.

These data reflect the changes which are constantly taking place as the agricultural land base is undergoing change with respect to land use. Marginal and submarginal cropland is transferring to forestland, pasture, and "Other Land" uses. Forestland in turn is transferring to "Urban and Built-up" and in some instances to cropland as farmers attempt to attain larger, more economical operating units.

2. Land Treatment Program

The application of needed conservation measures is an important factor in the management of the Basin land and water resources. Such a program will provide for the proper use and treatment of the land for sustained agricultural and forest production within the inherent capability of the soil.

1/ Source: U.S. Dept. of Commerce, Bureau of the Census, Census of Agriculture, 1954, 1959, 1964, 1969.

a. Status

The Indiana Soil and Water Conservation Needs Inventory (1967) indicates that 384,700 acres, or 29 percent of the Basin's 1,340,210 acres of cropland are adequately treated by land treatment measures aimed at conserving soil and water. Treatment is adequate on only 17,770 acres of the 188,890 acres of soils in cropland with a predominant erosion hazard ("e" subclass).

b. Degree of Land, Labor, and Capital Committment within Problem Areas

Capital requirements have increased substantially for most agricultural uses, especially during the past two decades. This is reflected by recent census data on value of land and buildings plus other expenditures in the Economic Area.

Total investment in land and buildings in 1969 was about 988.3 million dollars. This is an average of about $102,000 per farm, or $480 per acre. The large increase in this investment is shown in contrasting values for 1954 of $34,000 per farm and $230 per acre.

Other sizable investments in agriculture include machinery, equipment, livestock, fertilizer, and grain in storage. These investments have also increased significantly in recent years as mechanization has increased and farm owners and operators have substituted capital for labor.

The extent to which drainage has played a part in the development of the Economic Area is exemplified by the following data from the 1960 Census of Drainage 1/: (1) Over 90 percent of the farm land and about 76 percent of the total land area is in organized drainage projects; (2) The cost of drainage works and services from 1950-1959 was $1,463,000, of which 45 percent was for new drainage works and 55 percent was for maintenance, operation, repair, and administration of existing drainage works. These cost data exclude privately-owned drainage projects of less than 500 acres.

The extent of capital expenditure by individual landowners for on-farm drainage installations is estimated to be in excess of eight million dollars in the Basin area. This is based on the amount of drainage practices reported in SCS Records and Reports and average cost of installation.

1/ As of July 1, 1972 from SCS Records and Reports.

3. Soil and Water Conservation Districts

The nine counties in the Basin all have Soil and Water Conservation Districts which have been in existence for periods of time ranging from 9 to 29 years. These districts, established under State law as local units of government, are involved with all water, land, and associated resource problems within their boundaries. Their primary objectives are to develop and implement conservation plans in effect on all lands and assist in the solutions to land and water problems throughout the districts.

a. District cooperators, conservation plans and areas planned 1/.

A total of 5,221 landowners have become cooperators with their local soil and water conservation districts in the nine Basin counties. These agreements encompass a total of 1,063,569 acres.

Conservation plans have been prepared on 668,561 acres with 3,684 cooperators. These plans document decisions of landowners relative to the conservation use and treatment of soil and water resources of each individual land unit.

b. Practices applied

The specific conservation measures which have been applied to this date by landowners and operators in the Basin are many and varied. This would be expected in any area of this size having such variation in soils, topography, and natural features.

The more prominent erosion control practices include crop residue management, contour farming, diversions, pasture and hayland planting, and tree planting. Table III-20 lists the conservation practices and amounts applied in the Basin as of June 30, 1972.

4. Other Programs Affecting Adequacy of Land Management

The current annual levels of forest management assistance given landowners in the Economic Area are listed in Table III-21. The Indiana Department of Natural Resources, Division of Forestry, anticipates this level of accomplishment will be continued under their existing forest management programs.

The Indiana Division of Forestry utilization and marketing program was very active in Northern Indiana during 1972 and 1973. During the spring of 1972 there was a lumber short course sponsored by the Indiana Division of Forestry and the U.S. Forest Service. After attending 14 nights of instruction spread over a 14 week period of time there were 23 sawmill employees given certificates that recognized their successful completion of the course. The main objective

1/ As of July 1, 1972 from SCS Records and Reports.

TABLE III - 20: LAND TREATMENT MEASURES APPLIED
(As of 6-30-72)
Kankakee River Basin, Indiana

Land Use	Practice	Unit	Amount in Basin	Estimated Application Cost ($)
Cropland	Conservation Cropping System	Acres	417,617	
	Land Adequately Treated 1/	Acres	570,481	
	Crop Residue Management	Acres	335,497	
	Minimum Tillage	Acres	258,153	
	Contour Farming	Acres	5,842	
	Diversion 1/	Feet	204,319	
	Stripcropping	Acres	304	
	Terrace, Gradient	Feet	328,520	
	Terrace, Parallel	Feet	56,373	
	Drainage Main or Lateral	Feet	4,303,482	
	Drainage Field Ditch	Feet	234,949	
	Subsurface Drain	Feet	19,606,068	
	Land Smoothing	Acres	558	
	Open Channel	Feet	28,857	
	Pumping Plant for Water Control	No.	102	
	Structure for Water Control	No.	229	
	Grassed Waterway or Outlet	Acres	1,508	
	Subtotal Cropland			$11,435,000 2/
Grassland	Pasture & Hayland Management	Acres	21,454	
	Pasture & Hayland Planting	Acres	33,246	
	Spring Development	No.	10	
	Subtotal Grassland			$ 1,989,000
Forest land	Tree Planting	Acres	3,400	
	Woodland Improved Harvesting	Acres	920	
	Woodland Improvement	Acres	607	
	Subtotal Forest land			$ 281,000
Other land	Wildlife Wetland Management	Acres	1,492	
	Wildlife Upland Management	Acres	10,227	
	Wildlife Watering Facility	No.	23	
	Subtotal Other land			$ 918,000
Multiple	Pond	No.	270	
	Grade Stabilization Structure	No.	671	
	Critical Area Planting	Acres	1,925	
	Subtotal Multiple			$ 972,000
	Grand Total			$15,595,000

1/ Occurs in more than one land use.
2/ Does not include cost of annual recurring practices. (Price Base - 1972)

TABLE III - 21: CURRENT ANNUAL LEVELS OF FOREST MANAGEMENT ASSISTANCE
Kankakee River Basin (Economic Area), Indiana

Practice	Number Landowners	Acres
Classified Forest 1/	100	2,600
Forest Management Plans	20	600
Timber Marking	30	170
Timber Stand Improvement	6	30
Tree Planting	5	30

of this program is to encourage better private forest land management and protection. The incentive for landowners to classify their lands and practice better management are the reduction of the assessed value of classified lands to $1.00 per acre and continuous technical advice and assistance.

G. Electric Power Generation and Supply

One of the principal reasons for the construction of electrical power generating plants in the Basin is the availability of water. One critical criterion being used in the site selection of electric power generating plants is low-flow stream conditions. The average annual 7 day 1-in-10 year low-flow discharge of the Kankakee River at Dunns Bridge and at Shelby is 310 cfs and 403 cfs respectively. However fuel for these plants will need to be imported.

In July 1972 the Indiana Natural Resources Commission granted to the Northern Indiana Public Service Company, Inc. a permit to construct a 2,000 MW electric generating plant a short distance downstream from Dunns Bridge. Following Commission policy, water withdrawn for operating this generating plant will be restricted to Kankakee River flows in excess of 340 cfs, an amount slightly higher than the 7 day 1-in-10 year low-flow discharge at the Dunns Bridge site.

The possibility exists for there to be more than a single 2,000 MW electric generating plant on the Indiana portion of the Kankakee River. However, it should be recognized that there are other limiting factors to power plant siting other than a stream's low-flow condition, and the impact of these other considerations is expected to become more significant with time and as development of the Kankakee River Basin lands and streams is intensified.

1/ As of June 1973, a total of 13,066 acres, on 501 individual ownerships had been placed in the "classified forest" program.

Within the Kankakee River Basin there is one municipality owned electric generating company, and this is in the city of Rensselaer. The remaining electric power customers in this Basin purchase their power from either an investor owned utility or a Rural Electric Membership Cooperative (REMC), depending on where the customers reside.

The REMC's provide electric service to primarily the rural-farm customer, while customers living in cities-towns are generally provided electric service by Northern Indiana Public Service Company (NIPSCO), in whose service area they reside. Throughout most of the Basin the service areas of the REMC's and the investor owned utilities overlap; however, the REMC's in this part of Indiana purchase the power they sell to their customers from investor owned utilities.

IV. ECONOMIC DEVELOPMENT AND PROJECTIONS

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CHAPTER IV. ECONOMIC DEVELOPMENT AND PROJECTIONS

A. Historical Development

Prior to 1825 this Basin was inhabited by Indians, predominantly of the Potawotomi tribe. Much of the Basin at that time was in the "Grand Marsh." This marsh began near the northern border of Starke County in the now drained English Lake region and extended downstream to Momence, Illinois. This marsh area contained some 500,000 acres and had an abundance of fish, game, and fur bearing animals. French fur trappers began to come into the area in about 1825, and the first white settlers in this Basin settled in LaPorte County in 1829.

Small village settlements and trading posts began to develop around the edges of the Grand Marsh in about 1832, and the first sawmills and grain mills were established in 1836. With the westward movement of white settlers, the final removal of the Potawotomies by the U.S. Government occurred in the summer of 1838, though the lands of the Potawotomies had been ceded to the U.S. six years earlier in 1832.

In the early days trapping and fur trading was an important activity. The early French fur traders were friendly with the Indians and much trading occurred between these two groups. Many professional hunters were attracted to the Grand Marsh area because of its abundant wildlife. These hunters harvested a large amount of wildlife for Chicago and New York markets.

Then in 1852, the drainage movement of the Grand Marsh began when Indiana's Governor recommended to the legislature a bill for draining the marsh lands along the Kankakee River. It was the passage of this bill that subsequently led to the development of farms throughout much of this Basin. Cass and Singleton Ditches were dug in the summer of 1886 and were the first dredge ditches dug for reclaiming the marsh region. Many ditches were subsequently dug on both sides of the river and more complete drainage of this area has continued to this day to accommodate the principal economic activity of the Basin, agriculture.

Following the passage of the 1852 Drainage Act and initial activities to drain the marsh, timber harvesting in the marsh area became popular in the mid-1860's. The Indian Island Sawmill Company was formed in 1866 to log the valuable timbers. A river steamer and some flat boats were built to transport these timbers downstream to Momence, Illinois; however, the freighting business was not a successful economic venture and in the 1870's these boats were sold and redesigned as pleasure craft. In 1871 a massive forest and range fire burned out thousands of acres of marsh timber and grasses. Vegetation was burned down to the subsoil or to water level. Later in the 1870's and 1880's, the marsh became a great recreation area for hunters and hunt clubs were built throughout the marsh.

Gradually, more and more acres of marsh land were drained, which resulted in the destruction of vast amounts of wildlife habitat. Yet, as this process occurred, more and more acres of farmland were developed. Today, this is one of the most important agricultural areas in Indiana; particularly known for its abundant production of specialty and truck crops. Somewhat ironically, this area of the state currently uses the greatest amount of agricultural irrigation. Nevertheless, the total irrigated cropland acreage is relatively minor when compared to the total cropland acreage.

B. General Description

1. Population and Population Characteristics

The population of the Kankakee River Basin Economic Area was 1,081,371 in 1970. Population from 1940 to 1970 is shown by county and place of residence in Table IV-1.

TABLE IV - 1: HISTORICAL POPULATION
Kankakee River Basin (Economic Area), Indiana

County Name	1940	1950	1960	1970
Benton	11,117	11,462	11,912	11,262
Jasper	14,397	17,031	18,842	20,429
Lake	293,195	368,152	513,269	546,253
LaPorte	63,660	76,808	95,111	105,342
Marshall	25,935	29,468	32,443	34,986
Newton	10,775	11,006	11,502	11,606
Porter	27,836	40,076	60,279	87,114
Starke	12,258	15,282	17,911	19,280
St. Joseph	161,823	205,058	238,614	245,045
Area Total	620,996	774,343	999,883	1,081,317
Urban	454,665	588,169	787,859	870,566
Rural Farm	78,855	64,200	48,441	48,101
Rural Non-Farm	87,476	121,974	163,583	162,650

Source: U.S. Census of Population 1940, 1950, 1960, 1970

During the 1940 to 1970 time period Indiana's population increased at approximately the same rate as that of the nation. The population of the Kankakee Economic Area, however, increased at a much faster rate than the state with an increase of 74 percent. Increases in Lake and St. Joseph Counties accounted for 336,281 of the 460,321 total population increase. The most significant percentage increase occurred during the 1950's when the Economic Area population increased by 20 percent. During the 1960's the population growth rate declined to 8 percent, a rate less than the state recorded. The largest population percentage increase for the 30-year time period occurred in the Porter County portion of the area where the total population increased more than 212 percent. Porter County was the fastest growing county in the state between 1960 and 1970 when the population increased by approximately 45 percent.

The urban influence of the Economic Area is reflected by the fact that although the area includes only 12 percent of land area in the state, over 20 percent of the population resides within the Economic Area boundaries. Urban population has increased each 10-year period from 1940 to 1970 in absolute numbers as well as proportion of all persons. In 1940, 454,665 persons or 73 percent of the total population lived in cities or towns of 2,500 or more. The percentage had increased to 76 by 1950, 79 by 1960, and 81 by 1970.

The rural non-farm sector of the population also recorded a significant increase in population numbers in addition to percentage increase with 75,174 persons and 86 percent, respectively, for the 1940 to 1970 time period. A substantial proportion of this increase can be attributed to the growth of small towns (less than 2,500 inhabitants) and unincorporated areas on the urban fringe which have not been incorporated into areas classified as urban.

The rural population categorized as rural farm has decreased from 78,855 in 1940 to only 48,101 in 1970 or a 40 percent decrease. Major factors contributing to population decline in the farm sector include the substitution of capital for labor, increased farm efficiency, and the lure of attractive off-farm employment opportunities. A similar decline in the rural farm employment was recorded throughout the state and the nation.

The age structure of the Basin population is an important economic indicator. The proportion of the population in the 20-64 age group is considered economically productive in contrast to youth under 20 and persons aged 65 and over, which are considered the economically dependent proportions of the population. The size of each group in relationship to the entire population, at any given time, has considerable importance in terms of tax structure, income programs, production, institutional needs, government

decisions, and other social services. In an area where a high proportion of the population is in the productive age group (20-64 years of age), less governmental and social services are required than an area where the population is considered dependent. The age structure of the State of Indiana remained fairly constant during the 1960 to 1970 time period. The percentage of population under 20 years of age decreased only .1 percent to 39.1 percent in 1970. The 20 to 64 year old age group increased only .1 percent to 51.4 percent whereas the 65 and older group remained constant at 9.5 percent of the total population. The Kankakee Economic Area percentage of total population less than 20 years of age decreased from 41.2 to 40.5 percent for the 1960 to 1970 time period. The productive age group proportions of the total area population increased from 50.7 to 51.3 percent during the same time period. The 65 and older age group remained nearly the same by increasing from 8.1 to 8.2 percent of the total population from 1960 to 1970.

Total population in the economic Area is expected to increase to 1,373,600 by 1990 and to further increase to 1,941,800 by 2020. Current and projected populations for 1990 and 2020 are shown by county and place of residence in Table IV-2. It is expected that the Economic Area will continue to increase, but at a slower rate than the State of Indiana. Much of the growth can be attributed to the spreading influence of the Chicago megalopolis around the southern portion of Lake Michigan. In addition residential growth, in a leapfrogging nature, is expected to continue to occur along the major routes of transportation, especially in the area where recently completed Interstate 65 is located. The urban sector is expected to continue to increase to 1,142,700 by 1990 and to almost double by 2020 with 1,686,000 persons classified as living in urban places. More than 90 percent of the urban growth is projected to take place in Lake, Porter, and St. Joseph Counties. Urban population in Porter County is expected to increase from the current 55,726 persons to 406,400 persons or a 629 percent increase by 2020.

Population in the rural non-farm sector is projected to increase to 184,100 by 1990 and further increase to 210,800 by 2020. The major proportion of the rural non-farm increase is expected to occur in Marshall and Porter Counties. The increased rural non-farm population is expected to continue to be centered in small towns, unincorporated areas, and near industrial centers within or in proximity to the Economic Study Area. The rural farm population, however, is expected to continue to decline, but at a slower rate than in the past. Rural farm population is projected to decline to 45,000 persons by 2020.

TABLE IV - 2: CURRENT AND PROJECTED POPULATION BY COUNTY, 1970-2020
Kankakee River Basin (Economic Area), Indiana

COUNTY NAME	1970	1990	2020
Benton	11,262	11,900	13,200
Jasper	20,429	22,500	25,000
Lake	546,253	644,800	794,200
LaPorte	105,342	133,100	169,200
Marshall	34,986	41,500	51,900
Newton	11,606	11,700	12,000
Porter	87,114	188,500	457,400
Starke	19,280	22,100	26,100
St. Joseph	245,045	297,500	392,800
Area Total	1,081,317	1,373,600	1,941,800
Urban	870,566	1,142,700	1,686,000
Rural Farm	48,101	46,800	45,000
Rural Non-Farm	162,650	184,100	210,800

Source: State of Indiana Population Projections

2. Social Structures and Institutional Arrangements

The political structure of the Kankakee Economic Area has government authority vested in towns and cities in addition to county and township governmental units. Most of the governmental units have planning and zoning commissions and other regulatory agencies. Their major activity is planning in response to the increased population pressure and related economic problems.

Educational facilities in the Economic Area are adequate. Schools vary in size from small in the rural areas to those which are much larger in the more urban or consolidated school districts. Many of the rural students are transported to centrally located elementary and secondary schools in the larger towns. Over 296,000 persons were enrolled in elementary and secondary schools in 1970. For persons over 25 years of age, the median number of school years completed was 12.0 in the Basin and 12.1 for the State of Indiana. In 1970 over 58 percent of persons 25 years and older reported having completed high school, with an additional 15 percent having completed 4 or more years of college. Notre Dame University, located at South Bend, has the largest enrollment, 7,659 students in 1970; followed by Valparaiso University with 4,281. St. Mary's College, also in South Bend, and St. Joseph's College in Rensselaer have enrollments in excess of 1,000 students. Three other colleges in the area are Bethel College at Mishawaka, Ancilla Domini College at Donaldson, and Capuchin Seminary of St. Mary in Crown Point. Total student enrollment in 1970 at all these colleges and universities was nearly 15,500.

3. Employment and Economic Activity

Employment is an important indicator of comparability between areas. Generally an area's economic situation is determined by the type and number of persons employed. Employment in the Economic Area can be classified as either basic or non-basic. Basic employment includes work involved in producing goods for export (agriculture, mining, and manufacturing). Non-basic employment is the production of goods for consumption or use within the area. Trades, services (transportation, communications, finance, insurance, real estate, government, utilities, and personal and professional services), and construction are included in non-basic employment.

Employment in the Kankakee Economic Area is characterized by a decline in the relative importance of the agricultural sector and an increase in the manufacturing , trades, and services sectors (Table IV-3). In 1940, 9.8 percent of the employed persons in the Basin were engaged in agricultural, forestry, or fisheries activities. However, by 1970 the percentage of employment had decreased to 1.9 percent. The number of employees decreased from 20,460 to only 7,898 for the 1940 to 1970 time period. Thus, the employment pattern has followed other areas of the state by utilizing less employees in agriculture, forestry, and fisheries and a larger share of the work force in manufacturing, trades, and services. Employment in the manufacturing sector has increased from 101,176 employees in 1940 to 163,982 in 1970; however, the percentage of total employment decreased from 46.9 in 1940 to 40.8 in 1970.

Employment in all industries in the non-basic sector increased each 10-year period since 1940. Employment in services increased 57,166 persons between 1940 and 1970, whereas the finance, insurance, and real estate sectors had the largest percentage increase with 233 percent. It is noteworthy that 91.1 percent of the total labor force was located in Lake, St. Joseph, LaPorte and Porter Counties in 1970. The high concentration of employment is closely related to the degree of urbanization in the counties.

The Kankakee Economic Area is expected to have an employment increase of 151,820 employees by 1990 and to almost double employment by 2020 to 816,000 persons as shown in Table IV-3. The significant point in this tabulation is the continued trend to employment concentration in the non-basic sector. In the basic sector, future employment in agriculture is expected to continue to decrease; however, at a slower rate than historically. Agricultural, forestry and fisheries employment is projected to decrease from the present approximately 2 percent to about 1 percent by 1990 and to further decrease to less than 1 percent by 2020. However, employment in manufacturing is expected to increase during the projection time period, but at a slower rate than activities in the non-basic sector. Manufacturing employment is projected to increase to 187,800 in 1990, increasing further to 244,400 in 2020. The non-basic employment sector is expected to increase to 336,500 in 1990 and to 530,500 in 2020. The largest percentage increase in employment is projected to occur in governmental activity, growing from 11,521 employees in 1970 to 49,300 in 2020 or a 328 percent increase. However, this sector will still only represent 6 percent of the total employment. The greatest absolute increase in the non-basic sector is expected to occur in the services activity, growing from 91,225 in 1970 to 185,700 in 2020 and represent 22.8 percent of the total employment. In 1990 and 2020, services will be the second largest activity in the Kankakee Basin, with only manufacturing in the basic sector employing more persons.

Employment, sales tax collections, bank deposits, number and type of business establishments and sales, and the market value of all agricultural products are measures of economic activity. Sales tax collections in the Economic Area totaled $30,253,073 or over 14 percent of the state total collections for fiscal 1969-70. Over 50 percent of the total tax collection was obtained in Lake County. The magnitude of sales tax collection in the Economic Area can be illustrated by the fact that over 10 percent of the state's total collection is collected in Lake and St. Joseph Counties.

Bank deposits in the Kankakee Economic Area totaled $1.77 billion in 1970. Manufacturing firms numbered 806 for the area in 1960. However, by 1970 the number had increased to 935 or 16 percent increase when compared to the 1960 base. St. Joseph County accounted for 58 additional firms between 1960 and 1970, or over 44 percent of the increase. Wholesale trade sales for the area increased from $1,102,289 in 1963 to $1,304,349 in 1967. Retail trade sales for the same period increased 24 percent from $1.33 billion to $1.66 billion. Sales of agricultural products in the Economic Area are significant contributors to the economy. While many of the crops produced in the Basin might appear insignificant in the national scope, their production is vital to the local producers and to the local economy. Cash receipts from farm marketings increased from $141 million in 1964 to $176 million in 1969.

4. Income

Income is one of the best indicators of economic activity and prosperity of an area. Areas of low income are usually associated with a low level of education, a high unemployment rate, and out-migration. The better educated and young individuals in the labor force are mobile and are more likely to migrate to areas offering better employment opportunities in addition to higher wages. In 1970, 10.3 percent of all families in the nation had an annual income below $3,000 and 52.8 percent had an income of less than $10,000. The Kankakee Economic Area reported 6.8 percent of the families with less than $3,000 and 44.7 percent with an income of less than $10,000. The 1970 general income levels for the Kankakee Economic Area are shown in Table IV-4. The income levels are higher than most other regions of the State of Indiana due to the type of employment and related opportunities found in the area. Mean and per capita income varied considerably among counties. The more urbanized counties had the larger incomes, while the more rural counties recorded the lower incomes. Mean family incomes range from a high of $12,629 in Porter County to a low of $8,857 in Starke County, while the state averaged $10,959 for 1970.

The Kankakee Economic Area had a total of 269,073 families living in the area in 1970; however, 18,156 families or 6.7 percent were classified as having incomes below poverty level. The income of rural families below the poverty level tended to be higher than their urban counterparts. Over 10,000 families, or 55 percent of the families with an income of less than poverty level, are located in Lake County. The percentage of families in the poverty level ranges from 4.5 percent in Porter County to 11.1 percent in Starke County.

Projected per capita and total income for the area are presented in Table IV-5. Per capita income is expected to more than double

TABLE IV-3: HISTORICAL AND PROJECTED EMPLOYMENT 1940-2020
Kankakee River Basin (Economic Area), Indiana

Employment Category	1940	1950	1960	1970	1990	2000	2010	2020
Basic Activities								
Agriculture, Forestry, Fisheries	20,460	17,691	12,053	7,898	6,300	5,900	5,600	5,400
Mining	122	165	257	551	500	500	500	500
Manufacturing	101,176	145,066	158,057	163,982	187,800	207,600	226,000	244,400
Total Basic	121,758	162,922	170,367	172,431	194,600	214,000	232,100	250,300
Non-Basic Activities								
Contract Construction	7,427	15,572	18,419	23,142	43,300	54,400	65,600	78,300
Transportation and Communication	11,156	17,684	17,715	17,324	28,000	31,100	33,800	37,000
Wholesale and Retail Trade	32,131	49,032	59,086	76,499	101,100	119,000	135,600	152,600
Finance, Insurance and Real Estate	4,815	7,071	11,049	16,038	19,300	21,000	24,300	27,600
Services	34,059	43,984	63,356	91,225	114,300	138,400	161,400	185,700
Government	4,920	7,625	9,543	11,521	30,500	36,500	42,700	49,300
Total Non-Basic	94,508	140,968	179,168	235,749	336,500	400,400	463,400	530,500
Non-Classified	2,599	3,932	12,887	0	28,900	30,600	32,500	35,200
Total All Industries	218,865	307,822	362,422	408,180	560,000	645,000	728,000	816,000

Source: Census of Population 1940,1950,1960,1970 and Obers Series "C"
Population Projections.

TABLE IV - 4: INCOME CHARACTERISTICS BY COUNTY
Kankakee River Basin (Economic Area), Indiana

	Benton	Jasper	Lake	LaPorte	Marshall	Newton	Porter	St. Joseph	Starke	Area
All Levels										
Number of Families	2,887	4,819	134,846	26,378	9,070	3,043	21,322	61,842	4,866	269,073
Mean Family Income	$10,996	9,673	11,736	11,736	10,547	9,319	12,629	11,443	8,857	11,449
Per Capità Income	$ 3,105	2,575	3,156	3,193	2,979	2,703	3,370	3,225	2,415	3,157
Less Than Poverty										
Number of Families	250	408	10,004	1,516	679	275	965	3,521	538	18,156
Mean Size of Family	4.11	3.71	4.01	3.55	3.87	3.24	3.65	3.70	4.01	3.87
Percent of all Families	8.7	8.5	7.4	5.7	7.5	9.0	4.5	5.7	11.1	6.7
Mean Income per Family	$ 2,249	2,099	1,842	1,893	1,956	2,000	1,760	1,914	2,239	1,886

TABLE IV-5: PROJECTED PER CAPITA AND TOTAL INCOME 1970-2020
Kankakee River Basin (Economic Area), Indiana

Year	Per Capita Income Dollars	Total Personal Income Million Dollars
1970	3,148	3,410
1990	7,010	9,630
2020	15,850	30,780

Source: Office of Business Economics Projections - Economic Activity in the United States 1929-2020

the 1970 level by 1990 and increase to over five times by 2020. The state per capita income level is expected to increase from the 1970 level of $3,687 to $6,111 by 1990 and to further increase to $14,214 by 2020. Total personal income in the Economic Area is expected to increase from the current $3.4 billion in 1970 to $30.8 billion by 2020.

5. Current Growth Characteristics

Despite the natural advantages favoring growth in the agricultural sector, the Kankakee Basin has followed the change of other developing areas by utilizing a larger share of the work force for manufacturing, wholesale and retail trade, and service occupations while agriculture and related employment has declined. Agricultural activity in the area has not decreased as fast as the state average, but employment in public administration, the wholesale and retail trade sectors, and service sectors have increased at a faster rate than the state average. During the projection time period, wholesale and retail trade and the service sectors are expected to have increasing importance in the total economy. This will be due largely to their more rapid expansion than the other sectors of the economy. Increased leisure time, specialization of occupation, disposable income, and mobility will be responsible for creating an increased demand for services.

Development centers, where all necessary facilities, services, and amenities are provided, are attracting industry in the Basin. These centers are of two types: the development of new towns where people live, work, and play; and other centers where employment only is provided and employees reside in the surrounding area and commute daily to their respective places of employment.

6. Urban Centers and Their Influence

The Kankakee River Basin is favorably located in the center of mid-America's great manufacturing belt. It also has the added advantage of being ideally located on the fringe of a developing megalopolis: the Milwaukee-Chicago-Detroit-Buffalo corridor. The urbanization, population, market structure, and industries in the Basin are mainly a result of the influence of the adjacent urban centers. Secondary forces which facilitate the development and growth of the Kankakee area are the highly developed transportation network that allows for rapid residential and industrial expansion in the Basin. In addition, cities and towns in the area provide many of the raw materials that are utilized in the final manufacture of goods in the metropolitan centers.

7. Land Use

The Kankakee Economic Area encompasses 2,655,700 acres or nearly 12 percent of the State of Indiana. Land classified as inventory

(land utilized for agricultural and forestry production) reflects the importance of these industries in the Basin. Over 2,433,300 acres or almost 91 percent of the total area are utilized for these purposes and related industries. Cropland comprises 1,796,000 acres, pastureland 151,800 acres, forest land 188,300 acres, and other land 297,200 acres as shown in Table III-2. Over 97 percent of the land in Benton, Jasper, and Newton Counties is utilized for agricultural and forestry production, whereas only 85 percent of LaPorte County is classified as being used for the same purposes.

The non-inventory or non-agricultural land accounts for the remaining 222,400 acres in the Economic Area. Urban and built-up areas account for 92 percent or 206,300 acres in this category. St. Joseph County is the most urban-oriented county with about 46,600 acres of land area classified as urban and built-up. Lake, LaPorte, Porter, and St. Joseph and to a lesser extent Newton and Jasper Counties reflect the strong competition between agricultural and forestry usage and commercial and residential development. Historically, as land prices increase, land for agricultural use shifts to a higher use value.

In Lake County the average value of agricultural land increased from $404 per acre in 1959 to $707 in 1969. During the same time period, land in urban and built-up areas increased over 2,700 acres.

Current and projected land use by inventory and non-inventory acreage for the projection time period are shown in Table IV-6. Land available for agricultural and forestry production is expected to decrease 57,160 acres by 1990, further decreasing an additional 39,150 acres between 1990 and 2020. This decrease will be due to projected increases in urban and built-up areas for comparable time periods.

8. Transportation

The transportation facilities within the Basin and adjacent to urban centers are generally adequate. Transportation facilities in the area include airports, buses, trucks, railroads, and an adequate highway system. Michigan City, South Bend-St. Joseph County and Valparaiso-Porter County municipal airports provide commercial flights or air transportation service. In addition, there are six other public-owned airports in the Basin plus three privately-operated fields.

Railroads with major lines crossing the Basin include the Penn-Central, Grand Trunk Western, Baltimore and Ohio, Erie-Lackawanna, Chicago and Eastern Illinois, and the Illinois Central. Other railroads serving the Basin include the Norfolk and Western; Chesapeake and Ohio; Louisville and Nashville; and the Chicago, Milwaukee-St. Paul, and Pacific Railroad. Railroads provide

passenger service between some of the major cities and Chicago. Bus service is available between some of the major towns and cities in the Basin, but many of the rural areas have no public transportation. A large percentage of the Basin commerce is transported by trucking services. Numerous major highways provide access to most parts of the Basin. Major east-west routes include Interstates 80 and 90 (Indiana Toll Road), and U.S. Highways 20, 6, 30, 12 and 24. Major north-south routes include U.S. Highways 31, 35, 41, 421 and Interstate 65. Over 1,417 miles of state highways, 7,437 miles of county roads, and 2,665 miles of streets are located within the Economic Area. Motor vehicles remain the major mode of transportation with 568,202 vehicles registered in 1968.

TABLE IV - 6: CURRENT AND PROJECTED MAJOR LAND USE, 1968, 1990 and 2020
Kankakee River Basin, Indiana

Land Use	1968 1/	1990	2020
Inventory			
Cropland	1,162,000	1,176,200	1,238,800
Pasture	118,480	115,300	114,200
Forest	142,160	135,490	122,640
Idle Cropland	178,210	116,700	28,700
Other 2/	166,010	166,010	166,010
Total	1,766,860	1,709,700	1,670,550
Non-Inventory			
Urban and Built up 3/	130,130	187,290	226,440
Total Basin Area 4/	1,917,440	1,917,440	1,917,440

1/ Indiana Soil and Water Conservation Needs Inventory (1968)
2/ Includes: Farmsteads, Wildlife Areas, and Areas Not Otherwise Classified.
3/ Includes: Land Areas Utilized by Cities, Villages, and Other Built-up Areas of 10 Acres or More.
4/ Does not include water areas (18,050 acres) and Federal Non-Cropland.

C. Agriculture and Related Economic Activity

1. Major Crop Enterprises

Crop production makes a significant contribution to the economy of the Kankakee Economic Area. The crops grown reflect the Basin's relationship to the "cornbelt." The major share of feed grain output is utilized for the production of livestock and livestock products. Feed grains (including corn, oats, and barley) utilize over half the agricultural cropland acreage. Food grains such as soybeans and wheat are another important source of income for the area. Current normal 1/ and projected crop acreages are shown in Table IV-7. There are 1,458,690 acres available for agricultural production in the Basin. Corn is the predominant grain crop. It is grown on over 592,000 acres and accounts for over 51 percent of the cropland harvested. In addition, nearly 21,000 acres of corn for silage are harvested. Almost 41,000 acres of oats, barley, and other small grains are grown for livestock feed. Hay is a major source of roughage utilized for livestock production in the Basin. Currently, over 50,000 acres are utilized for hay production. Alfalfa and alfalfa mixtures account for almost 60 percent of the hay production.

The increased demand for soybeans and soybean by-products has resulted in a noticeable increase in the cropland acreage utilized for soybean production. Currently, over 348,000 acres of cropland are devoted to soybean production. Wheat remains a major crop with over 4 percent of the cropland harvested acreage. Over 13,000 acres of cropland are utilized for vegetable and specialty crop production in the Basin. Potatoes, mint, popcorn, and grass sod utilize the major portion of the acreage in specialty crops.

Pastureland in the Basin encompasses 118,484 acres or 8 percent of the land presently available for agricultural production. Grazing of the pastureland serves as a major source of roughage for the production of livestock products in the Basin. Projected crop production acreages for the Basin reveal that by 1990 over 116,700 acres will remain idle. However, by 2020 this acreage is expected to decrease to about 28,900 acres. Table IV-7 also reveals that by 1990 over 50 percent of the cropland harvested will be utilized for the production of corn for grain. The

1/ Current normal represents cropland and pastureland acreage and production in an average year using current production technology. In this report, current normal is based upon 10-year period 1963-1972. The normalization process removes abnormalities caused by weather, other hazards, and farm programs which make a single year unreliable for a land use and production base.

acreage of corn for grain is expected to increase to nearly 735,000 acres or 59 percent of all cropland harvested by 2020. In contrast, soybean acreage is expected to increase only 19,000 acres by 1990 to 367,000 acres and to further increase to about 379,000 acres by 2020. Corn for silage and vegetable acreages are expected to increase during the projection time period. The acreage utilized for the production of hay, rotation pasture, wheat, and other small grains is expected to decrease substantially by 2020.

TABLE IV-7: CURRENT NORMAL AND PROJECTED ACREAGE OF PRINCIPAL CROPS 1/
Kankakee River Basin, Indiana

Crop	Current Normal	1990	2020
	Acres		
Corn for Grain	592,158	664,600	734,500
Corn for Silage	20,574	20,300	22,700
Soybeans	348,279	367,000	378,800
Wheat	52,532	35,100	29,900
Alfalfa Hay	29,919	15,800	10,200
Other Hay	20,205	9,800	5,400
Small Grain	40,891	34,700	30,100
Cropland/Rotation Pasture	43,905	13,200	8,800
Vegetable	13,529	15,700	18,400
Idle	178,214	116,700	28,900
Total Cropland	1,340,206	1,292,900	1,267,200
Improved Pasture	114,793	111,800	110,700
Permanent Pasture	3,691	3,500	3,500
Total Pasture	118,484	115,300	114,200

1/ Projections based upon methodology as described in 1972, OBERS Projections of Regional Activity in the U.S. (Series C Population). Volume 1, Concepts, Methodology, and Summary Data, U.S. Water Resources Council, 1972.

2. Major Livestock Enterprises

The sale of livestock and livestock products serves as one of the major sources of income in the Kankakee Economic Area. A large portion of total farm sales has been derived from the sale of livestock and livestock products. Cattle, hogs, and dairy are the most important livestock enterprises. Historically, beef cattle and hog numbers have been increasing in the area. Many animals are purchased as feeder animals outside the area. Most of the cattle, hogs, and sheep sold in the area are fattened for market in farm feedlots. They consume the major portion of the feed grains produced in addition to a substantial portion of the forage produced in the Basin.

In contrast, dairy cows and sheep numbers have been decreasing. Milk production per cow has been increasing, thus total milk production has not decreased substantially. The trend in dairying has been toward fewer and larger operations producing whole milk rather than cream. Poultry production has been expanding; however, broiler production varies widely from year to year depending mostly on the prevailing price.

3. Volume and Value of Production

Major cropland, livestock and livestock product production are shown in Table IV-8. The productions of corn for grain, corn silage, and soybeans are expected to more than double by 2020. Pasture production is projected to increase at a slower rate. Wheat and hay production are the only major crops expected to decline in production during the projection time period. Beef and veal, pork, turkey, and egg production is expected to increase by 1990 and to further increase by 2020. In contrast, the production of lamb and mutton, broilers, and milk are projected to decrease during the projection time period.

The value of agricultural production in the Kankakee River Basin for the current normal, 1990 and 2020 time periods, is shown in Table IV-9. By 1990, the value of agricultural production in the Basin will be over $333 million. However, by 2020 an increase of over $105 million to almost $439 million is expected for an increase of 86 percent over the current normal value of production.

4. Employment and Income

Historically, the proportion of workers employed by the agricultural sector has been declining. In addition, the number of farm operators reported working off the farm is increasing with a majority reporting 100 or more days of work off the farm.

TABLE IV - 8: CURRENT NORMAL 1/ AND PROJECTED PRODUCTION OF SELECTED AGRICULTURAL COMMODITIES 2/
Kankakee River Basin, Indiana

	Units	Current Normal	1990	2020
		---thousands---		
Corn, Grain	Bu.	51,223	82,500	115,400
Soybean	Bu.	11,145	16,100	21,800
Wheat	Bu.	1,923	1,760	1,860
Corn, Silage	Ton	296	445	670
All Hay	Ton	150	114	77
All Pasture	AUD's	21,883	26,540	30,782
Beef & Veal	lbs.	65,300	75,700	105,000
Pork	lbs.	115,200	198,000	260,000
Lamb & Mutton	lbs.	1,800	1,100	800
Broilers	lbs.	2,300	530	200
Turkeys	lbs.	2,700	8,000	11,170
Milk	lbs.	280,000	240,000	210,000
Eggs	Doz.	15,200	18,600	21,000

1/ Current normal represents production on an average year using current production technology. In this report, current normal is based upon 10 year period 1963-1972. The normalization process removes abnormalities caused by weather, other hazards, and farm programs which make a single year unreliable for a land use and production base.

2/ Projections based upon methodology as described in 1972 OBERS Projections of Regional Activity in the U.S. (Series C Population). Volume 1. Concepts, Methodology, and Summary Data, U.S. Water Resources Council,1972. The reader should refer to this source if greater detail is desired.

TABLE IV-9: ESTIMATED CURRENT NORMAL AND PROJECTED VALUE 1/ OF AGRICULTURAL PRODUCTION
Kankakee River Basin, Indiana

	Current Normal	1990	2020
		(1000 dollars)	
Crops	142,918.1	211,760.8	287,038.2
Livestock	92,674.5	121,433.0	151,903.6
Total	235,592.6	333,193.8	438,941.8

1/ Agricultural Price Standards for Water and Related Land Resource Planning, United States Water Resources Council, Washington, D.C., February 1974

However, a significant number of employees classified as non-agricultural workers contribute to the agricultural labor force in the Basin. The trend of fewer farm operators, more farm operators working off the farm, and a significant contribution of farm labor from persons classified as workers in other sectors of the economy is expected to continue during the projection time period. Workers classified as agricultural employees are projected to decrease to 1,425 persons in 1990 and to further decrease to 1,150 persons in 2020.

Farm income in the Basin is estimated to be $91.9 million in 1950 as shown in Table IV-10. Major components of farm income are value of production, rental value of farm buildings, recreational income, consumption of home-grown products, and government payments. Value of farm production was the major contributor accounting for over 92 percent of all farm receipts. Other sources of farm receipts accounted for only $18.8 million in 1970. Projected net income in the Basin is expected to increase to $130.6 million by 1990 and to $172.6 million by 2020 for an 87 percent increase during the projection time period.

TABLE IV-10: CURRENT NORMAL 1/ AND PROJECTED AGRICULTURAL INCOME
Kankakee River Basin, Indiana

	Current Normal	1990	2020
		(1000 dollars)	
Value of Production	235,592.6	333,193.8	438,941.8
Other Receipts	18,847.4	26,655.2	35,115.2
Total	254,440.0	359,849.0	474,057.0
Total Expenses	162,587.2	229,223.8	301,500.3
Net Income	91,852.8	130,625.2	172,556.7

1/ Agricultural Price Standards for Water and Related Land Resource Planning United States Water Resources Council, Washington, D.C., February 1974.

5. Capital Investment

Capital investment requirements have expanded rapidly for the agricultural as well as the non-agricultural sector. The value of farmland and buildings in the Economic Area is typical of this trend. Total investment in land and buildings in 1969 was over $988 million compared to $684 million in 1959. Average value of land and buildings per acre and per farm for 1954, 1959, 1964 and 1969 in the area is shown in Table IV-11.

TABLE IV-11: VALUE OF LAND AND BUILDINGS[1/]
Kankakee River Basin (Economic Area), Indiana

Value of Land and Buildings	1954	1959	1964	1969
		Dollars		
Per acre	232	319	375	481
Per Farm	34,273	55,438	75,374	101,904

The more rapid increase in the value of land and buildings per farm is due primarily to the trend towards increased farm consolidation and enlargement.

Other sizable investments in agriculture include machinery, equipment, and livestock. No attempt was made to value these investments; however, investments in agriculture will increase as mechanization continues to replace labor. Capital investments in agriculturally related industries will also continue to increase in the future.

D. Forest Resources and Related Economic Activity

1. Extent and Nature of the Resources

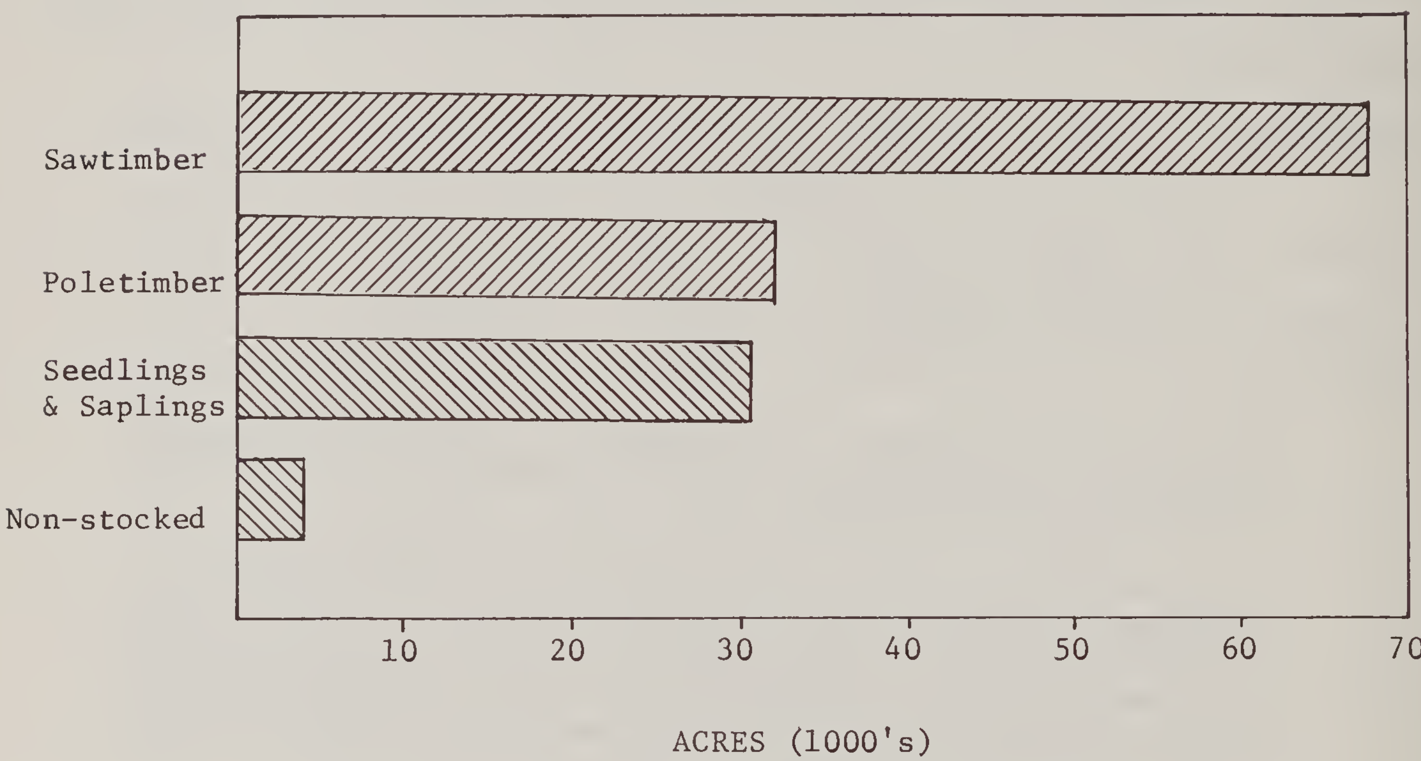
Forest land occupies 142,162[2/] acres of the Basin area. Of this amount, 131,365 acres are classed as commercial forest land and 10,797 acres are non-commercial forest land.

About 3.6 thousand acres of the Basin's commercial forest land is classed as non-stocked (Figure IV-1). This includes idle

1/ Source: U.S. Census of Agriculture, 1954, 1959, 1964, and 1969.
2/ Source of Basic Data-North Central Forest Experiment Station, St. Paul, Minnesota.

farmland reverting to forest land but still in brush transition stage, and stands of trees that are too poor in quality because of fire damage and other abuse. The distribution of the remaining commercial forest land is: 67.7 thousand acres, sawtimber; 30.2 thousand acres, poletimber; and 29.8 thousand acres of seedling and sapling size stands.

Figure IV-1: COMMERCIAL FOREST AREA BY STAND-SIZE CLASS, 1967
Kankakee River Basin, Indiana



Sawtimber stands are defined as stands at least 10 percent stocked with growing stock trees, with half or more of this stocking in sawtimber or poletimber trees, and with sawtimber stocking at least equal to poletimber stocking. Poletimber stands are at least 10 percent stocked with growing-stock trees, one-half or more of this stocking in sawtimber trees and with poletimber stocking exceeding that of sawtimber. Seedling and sapling stands are at least 10 percent stocked with growing-stock trees and with seedling and/or saplings comprising more than half of the stocking.

The area of commercial forest land by major forest types is shown in Table IV-12.

TABLE IV-12: AREA OF COMMERCIAL FOREST LAND BY MAJOR FOREST TYPE, 1968
Kankakee River Basin, Indiana

Forest Type	Acres (Thousand Acres)
Northern Pines	0.5
Oak-Hickory	63.7
Pin Oak-Maple-Tamarack	4.2
Elm-Ash-Cottonwood	30.2
Maple-Beech-Birch	31.6
Aspen-Birch	1.2
Total All Types	131.4

Source: North Central Forest Experiment Station, St. Paul, Minnesota.

These major forest types are defined as:

Northern Pines
Forests in which white, red, and jack pines, singly or in combination, comprise a plurality of the stocking. In Indiana this type occurs principally as plantations. Large native white pine can be found scattered throughout the area as single trees or as small groups of trees. Common associates include sugar maple, hickory, yellow-poplar, and ash.

Oak-hickory
Forests in which upland oaks or hickory, singly or in combination, comprise a plurality of the stocking. Common associates include yellow-poplar, elm, maple, black walnut, black locust, and catalpa.

Pin-Oak-Maple-Tamarack
Bottomland forests in which pin oak, soft maple, and tamarack, singly or in combination, comprise a plurality of the stocking. Common associates include cottonwood, willow, ash, and elm.

Elm-ash-cottonwood
Lowland forests in which elm, ash, cottonwood, or soft maple, singly or in combination, comprise a plurality of the stocking. Common associates include willow, sycamore, and beech.

Maple-beech-birch
Upland forests in which hard maple or beech, singly or in combination, comprise a plurality of the stocking. Common associates include elm, basswood, and soft maple.

Aspen-birch
Forests in which aspen, balsam, poplar, paper birch, or gray birch, singly or in combination, comprise a plurality of the stocking. Common associate is soft maple.

The rate or growth and cut is highest in northern Indiana, despite the fact that nearly 80 percent of the state's timber volume is in the South.1/ Northern Indiana's growing stock inventory is 22 percent of the state total, but its removals and growth are 34 and 36 percent respectively of the total.

Study projections indicate there will be a net loss of forest land from the year 1967 through 2020 of 14 percent. (Table IV-13) This amounts to the loss of an estimated 18 thousand acres of forest land to other uses by the year 2020. Most of this loss is expected to be conversion of forest land to pasture and cropland. The remaining is projected to be converted to urban use and road and utility rights-of-way.

TABLE IV - 13. ACRES OF COMMERCIAL AND NON-COMMERCIAL FOREST LAND FOR 1967, WITH PROJECTIONS FOR 1970, 1980, 1990, 2000, 2020
Kankakee River Basin, Indiana

	1967	1970	1980	1990	2000	2020
				(Thousand Acres)		
Total Forest Land	142.2	141.1	137.5	135.5	133.6	122.6
Commercial Forest Land	131.4	130.4	127.0	125.2	123.4	113.3
Non-Commercial Forestland	10.8	10.7	10.5	10.3	10.2	9.3

1/ Industrial wood is logs, bolts or other roundwood sections cut from trees for industrial or consumer use.

This is a significant loss, considering the scarcity of the resource (about 8 percent of the total area) and the need for this type of land use in satisfying the recreational needs of the Basin's ever increasing population.

The forest lands of the Basin support nearly 106 million cubic feet of growing stock timber[1/]. This volume is predominately in hardwood species with softwood representing less than one percent of the total (Table IV-14). Growing stock volumes of live, sound trees in Indiana have shown an increase of nearly 25 percent during the period 1950 to 1967[2/]. The primary reason for this increase in growing stock inventory is the continuing surplus of net annual growth over timber removals. The limited and sporadic market for poletimber size trees for use in the pulpwood markets is the main reason growing stock removals have not been higher. Improved technology in the use of small hardwoods for pulp is expected in the near future, and this may lessen the gap between growing stock and removals. The Kankakee River Basin has shown a slight decrease in cubic feet of growing stock during this same period of time. The timber removals in the Basin are still below the net annual growth figures, but not nearly so much as the state average. Average annual timber removals are also less than the average annual allowable cut[2/]. Annual allowable cut is the volume that could be cut while bringing the forest to a more productive condition and improving the distribution of age classes and species composition. It assumes an equal level of management regardless of ownership and that level of management will be similar to that applied on national forest land. While allowable cut is only a guide, it does balance timber removals against levels of cutting desired for a forest not fully managed. Under a fully managed condition for timber production, growth and cut would be equal.

Approximately 1.3 million cubic feet of industrial wood products were produced from the forest land of the Basin in 1970. These products included pulpwood, sawlogs, veneer logs, fuel wood, fence posts, and other industrial products. Practically all of this output came from the hardwood timber. Projections indicate that by the year 2020 approximately 4.5 million cubic feet of industrial wood products will be harvested (Table IV-15).

Improved markets in terms of reliability and prices paid to landowners for forest products has created an increased interest in forestry by landowners and operators in the Basin. This interest has manifested itself in improved forest management of existing stands and in establishments of some plantations of walnut and pine. Several landowners are presently involved in the commercial production of Christmas trees.

1/ Volume of sound wood in merchantable trees.
2/ USDA Forest Service Resource Bulletin NC-7, 1969.

TABLE IV - 14. NET VOLUME OF GROWING STOCK AND SAWTIMBER ON COMMERCIAL FORESTLAND BY SPECIES GROUP, 1970 KANKAKEE RIVER BASIN, INDIANA

SPECIES	Growing Stock (Million Cubic Feet)	Sawtimber (Million Cubic Feet)
Softwoods	0.7	0.1
White Oak Group	15.1	11.0
Red Oak Group	22.4	16.4
Hickory	10.2	5.1
Hard Maple	7.2	4.7
Soft Maple	4.8	2.8
Beech	3.0	2.4
Ash	9.4	4.6
Cottonwood	6.3	5.1
Yellow Poplar	3.4	2.4
Sycamore	4.1	2.9
Other	19.3	9.1
All Species	105.9	66.6

Source: North Central Forest Experiment Station, St. Paul, Minnesota

TABLE IV-15. PRODUCTION OF INDUSTRIAL WOOD PRODUCTS FROM ROUND WOOD 1970-2020 Kankakee River Basin, Indiana 1/

	1970	1980	1990	2000	2020
	(Thousand Cubic Feet)				
Production of Industrial Wood	1,301	2,233	3,000	4,031	4,465

2. Current and Projected Growth

The production of industrial wood 2/ in the Basin is expected to increase from about 1.3 million cubic feet in 1970 to 4.5 million cubic feet by the year 2020. This projected increase assumes improved harvesting techniques, utilization of material not now salvaged or removed from the forest, increased supply of growing stock generated by improved management, and a reduction in losses caused by insects and diseases.

1/ Source of basic data - U.S.D.A. Forest Service Resource Bulletin NC-7, 1969
2/ Industrial wood is logs, bolts or other roundwood sections cut from trees for industrial or consumer use.

Currently, there are good markets in the Basin for all size and species of trees except for the poletimber and smaller sizes. The largest user of the raw forest products is the lumber mill. Here, everything from lumber to pallet stock is produced and in some cases, high grade veneer logs are graded out and sent to other markets. Several "blocking" plants operate sporadically throughout the area. Northern Indiana is also a good producer of high-quality veneer-grade walnut as well as lumber-grade and gun-stock grade walnut. Most of this material is processed outside the Basin.

Black walnut deserves special mention because of its high value and short supply of large diameter trees in Indiana and throughout its entire range. Between 1950 and 1967, black walnut growing-stock volume on commercial forest land remained constant. Volume losses in the larger diameter groups were more than offset by gains in the smaller diameter group. Sawtimber volume of walnut increased slightly. A substantial gain was made in the 11.0 to 14.9 inch diameter group, but all other classes showed losses[1/].

The demand for veneer-quality and sawlog-quality black walnut will increase in the future, making this species one of the most prized and highest priced species in the country. Because of this, walnut will undoubtedly be managed much more intensively in the future than it has in the past.

Although to a lesser degree, this same reasoning holds true for many other hardwood species found in the Basin; demand for hardwood sawtimber is expected to triple between 1962 and 2000[2/]. It is imperative, therefore, that landowners in the Basin initiate good forest management on their forest lands if they are to take advantage of the anticipated improved markets and higher prices to be paid for high quality hardwoods.

3. Employment and Income in Primary Processing and in Related Trade and Service Industries

Currently in the Kankakee River Basin, there are 78 active wood using industries. Of this number, 27 are engaged in primary processing such as sawmills, planning mills, veneer and plywood plants, and preserving plants. The remaining 51 industries are engaged in secondary processing operations including veneer millwork, wood containers, wood furniture, office furniture, and wood partition manufacturing.

1/ USDA Forest Service Resource Bulletin NC-7, 1969
2/ USDA Forest Service - Timber Trends in the United States Forest Service Rep. 17, 235 p., 1965.

An estimated 2,369 persons are employed by these 78 industries and receive an average annual payroll of $12,233,100 (Table IV-16). Study projections indicate an increase in employment in wood using industries through 1980 and then a gradual decline in employment through the year 2020. Income through payrolls is projected to increase throughout the study period, reaching a high of $29,457,500 by the year 2020. The decrease in numbers employed beyond 1990 will result from improved technology in harvesting and milling processes requiring fewer employees and hence higher payrolls.

Greater demand for forest products in the future will generate higher prices paid for standing timber, and this together with less rigid product specification and improved utilization, will increase the profitability of timber growing, harvesting, and manufacturing.

4. Capital Investment

Capital investment and operating cost for the forest products industries are increasing. This increase is attributed to the continuing efforts of mills to improve utilization of raw materials, meet requirements for improved pollution control imposed through regulatory activities, and new mill construction.

E. Outdoor Recreation and Related Economic Activity

Table IV-17 shows an inventory of the designated recreational land and water areas in the Economic Area. Outdoor recreation utilizes 58,926 acres of land and water, approximately two percent of the area. Distribution shows 47,473 acres, or about 80 percent, in public ownership and the remaining 11,453 acres in private ownership but administered for general public use. About 45 percent of the designated recreational areas are in Newton and Porter Counties. The economic activity associated with these recreational areas is important to the area.

TABLE IV - 16: EMPLOYMENT AND INCOME IN PRIMARY AND SECONDARY FOREST PROCESSING 1973, 1980, 1990, 2000, 2020
Kankakee River Basin, Indiana

	1973	1980	1990	2000	2020
No. of Employees					
Primary Mfg.	139	188	185	183	129
Secondary Mfg.	2230	3032	2951	2869	2146
Total	2369	3220	3136	3052	2275
Total Income (Employees)			(Thousand Dollars)		
Primary Mfg.	710.0	1,090.8	1,338.9	1,580.0	1,649.5
Secondary Mfg.	11,523.1	17,768.1	21,518.8	25,029.8	27,808.0
Total	12,233.1	18,858.9	22,857.7	26,609.8	29,457.5
Average Income per employee (dollars)	5,164	5,857	7,287	8,719	12,948
Average Output per employee (cubic feet)	549	693	932	1,321	1,963

Source: Indiana Department of Natural Resources

TABLE IV - 17: INVENTORY OF DESIGNATED RECREATIONAL LAND AND WATER AREAS
Kankakee River Basin (Economic Area), Indiana

County	Land Area		Lakes		Streams		Wetlands		Total		
	Public	Other	Public	Other	Public	Other	Public	Other	Public	Other	Total
	ACRES										
Benton	156	10	1	8	--	--	--	--	157	18	175
Jasper	4,053	312	740	9	--	--	200	--	4,993	321	5,314
Lake	5,178	2,802	431	71	21	--	345	37	5,975	2,910	8,885
LaPorte	5,696	1,671	272	62	41	--	886	40	6,895	1,773	8,668
Marshall	393	1,020	15	1	--	--	--	--	408	1,021	1,429
Newton	9,212	1,004	1,801	4	26	--	700	166	11,739	1,174	12,913
Porter	12,339	1,626	42	50	--	10	280	197	12,661	1,883	14,544
Starke	2,234	692	--	4	36	0	0	0	2,270	696	2,966
St. Joseph	2,258	1,650	27	4	2	3	88	--	2,375	1,657	4,032
TOTAL	41,519	10,787	3,329	213	126	13	2,499	440	47,473	11,453	58,926

Source: Shaping the Future, Indiana Department of Natural Resources, August 1969. Appendix I.

V. PROBLEMS AND NEEDS FOR DEVELOPMENT OF WATER AND RELATED LAND RESOURCES

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CHAPTER V.
PROBLEMS AND NEEDS FOR DEVELOPMENT OF WATER AND RELATED LAND RESOURCES

A. Land Treatment [1]

Proper use and management of the land for sustained agricultural and forest production are basic needs in the conservation, development, and utilization of land and water resources. The characteristics of the various soils must serve as a guide to developing both broad land use plans and to guide individual landowners in making proper land management decisions.

1. Types of Problems and Need for Land Treatment

Approximately 188,900 acres of the Basin's 1,340,210 acres of cropland are subject to erosion problems and currently in need of treatment for control of sheet erosion. Nearly 151,000 acres of cropland are located on areas having unfavorable soil conditions, primarily droughtiness. The problems of unfavorable soil conditions are scattered throughout the Basin, but the erosion problems are concentrated along the northern Basin boundary. Table V-1 summarizes the area affected by these problems within each land capability unit. Flooding and poor drainage are major problems as exemplified by the fact that excess water is the dominant problem on 851,500 acres or 63.5 percent of the Basin cropland. Treatment is currently adequate on 384,700 acres (28.7 percent of the 1,340,210 acres of cropland in the Basin). Proper management practices such as crop residues, annual cover crops, and sod in the crop rotation can meet the treatment needs on 330,790 acres (approximately 35 percent of the 955,510 cropland acres needing treatment). Mechanical practices such as contour farming and stripcropping, and the use of terraces or diversions are needed on 140,640 acres of cropland (15 percent of the area needing treatment). Approximately 439,350 acres, representing 46 percent of the cropland treatment needs, have a predominant need for an adequate drainage system for the removal of excess water.

There are approximately 35,730 acres (30 percent) of grassland which are adequately treated. An additional 1,130 acres or less than 1 percent is not feasible to treat based on a reasonable return on the investment.

A total of 81,630 acres (68.9 percent) of the grassland is in need of treatment and is feasible to treat. The predominant treatment need is for reestablishment of vegetative cover on 30,820 acres (26 percent). This occurs where the pasture is in such poor condition that it needs complete reestablishment. This

1/ Data within this section based upon Indiana Soil and Water Conservation Needs Inventory (1968) and the 1969 U.S. Census of Agriculture - Indiana

generally requires the application of fertilizers and seed in conjunction with the elimination of woody and noxious plants by chemical or mechanical means. Protection from grazing must also be provided until the cover is adequately reestablished. Table V-2 is a summary of the treatment needs for grassland as they currently exist in the Kankakee River Basin.

Treatment is currently adequate on 56,650 acres (40 percent) of the total forestland in the Basin (142,160 acres). Proper management practices such as timber stand improvement; improved harvesting practices; and protection from grazing, insect, disease, and fire damages can meet the treatment needs on nearly every acre of forestland whether the need be for timber production, recreation, or wildlife habitat improvement. Commercial Christmas tree production should be emphasized on some of the less productive sites. This is compatible with wildlife management and provides employment during the harvesting process. These treatment needs currently exist on 85,510 acres of forestland.

Livestock exclusion is needed on nearly 31 thousand acres of forestland; tree planting is needed on almost 22 thousand acres; and timber stand improvement is needed on a little over 61 thousand acres. These measures are aimed primarily at reducing damages to the hydrologic conditions of the forest soils and bringing the productivity of the forest stands more in line with their capabilities. At present approximately 35 thousand acres of forestland are adequately treated for protection from grazing damage, and nearly 57 thousand are adequately treated for production of timber.

Insect and disease damage, which is only a minor problem on the forestland, will be further reduced by maintenance of current information and education, detection, and control programs.

Forest fires are not a serious threat to planned programs for forestland management and treatment. Fire prevention and control measures under the local fire departments are adequate to keep the area annually burned within state and program goals. Maintenance of going programs will insure adequate protection of the forestland from fire.

Multiple-use management of the Basin forestland needs to be accelerated to help fulfill the ever-increasing demands on this shrinking resource. Not enough is known of the potentials or limitations of multiple-use. A great deal needs to be learned about the extent to which different intensities of uses are or are not compatible and also about management techniques that can foster optimum production of each use while protecting the values of other uses. There is a limit to the amounts and kinds of goods and services which any given unit of land can yield. As pressure for production from the land increases, it becomes imperative that sound land management give emphasis to the multiple uses of land. Under proper management, landowners can produce timber crops, enhance recreation, improve wildlife habitat, and improve water quality. Environmental or open space corridors along the Basin streams should be maintained and enhanced where possible. Benefits would include recreation, fish and wildlife, water quality, and timber production.

In summary, land treatment to reduce erosion and improve production efficiency is needed on 683,300 acres of agricultural land. This includes about 171,120 acres of cropland which have a need for control of sheet erosion. In addition, about 439,350 acres of cropland have a need for adequate drainage systems.

TABLE V - 1. PREDOMINANT CROPLAND HAZARDS BY LAND CAPABILITY CLASS
KANKAKEE RIVER BASIN, INDIANA

Land Class	Dominant Hazard (Acres) Erosion	Droughtiness	Excess Water	None	Total Area
I	-	-	-	148,890	148,890
II	126,540	34,830	484,990	-	646,360
III	44,680	67,950	239,720	-	352,350
IV	16,200	42,930	126,800	-	185,930
VI	1,250	3,940	-	-	5,190
VII	220	1,270	-	-	1,490
VIII	-	-	-	-	-
Total	188,890	150,920	851,510	148,890	1,340,210
Area Adequately Treated 1/	17,770 (9.4%)	40,120 (26.6%)	252,420 (29.6%)	74,390 (50.0%)	384,700 (28.7%)

Source: Indiana Soil and Water Conservation Needs Inventory, 1968.

TABLE V - 2. GRASSLAND TREATMENT NEEDS, 1968
KANKAKEE RIVER BASIN, INDIANA

Treatment Needed	Acres	Percent of Grassland
None, treatment is adequate	35,730	30.2
Not feasible to treat	1,130	0.9
Protection from overgrazing	6,790	5.7
Improvement of plant cover	24,010	20.3
Brush control & improvement of plant cover	9,020	7.6
Reestablishment of vegetative cover	8,420	7.1
Reestablishment of vegetative cover and brush control	30,820	26.0
Change in land use	2,560	2.2

Source: Indiana Soil and Water Conservation Needs, 1968.

1/ Land on which the current conservation treatment is adequate to meet the conservation problems.

2. Need for Land Use Adjustments

There are 35,900 acres (2.7 percent) of the cropland in the Basin which needs a change to permanent cover of grass or trees. This need occurs primarily on cropland in capability classes IVs and IVw. Table V-3 summarizes the cropland acreage which needs a change in land use to permanent cover.

TABLE V - 3. CROPLAND NEEDING LAND USE CHANGE, BY LAND CAPABILITY CLASS AND SUB-CLASS
Kankakee River Basin, Indiana

Capability Class & Sub-Class	Cropland Acres Needing Land Use Change
IIe	2,060
IIw	220 1/
IIIe	1,520
IIIs	2,750
IIIw	640
IVe	1,660
IVs	16,940
IVw	6,740
VIe	420
VIs	2,090
VIIe	220 1/
VIIs	640
TOTAL	35,900

Source: Indiana Soil and Water Conservation Needs Inventory (1968)

1/ Consists of numerous small areas which must be managed in accordance with capability class of larger adjacent areas.

A change in land use from grassland to forestland is needed on 2,560 acres (2.2 percent) of the Basin's grassland. Table V-4 shows the grassland acreage which should be converted to forestland by capability class and sub-class. The principal need is for erosion control on sand ridges that are highly susceptible to wind erosion.

TABLE V - 4. GRASSLAND TO FORESTLAND CONVERSION NEEDS, BY LAND CAPABILITY CLASS AND SUB-CLASS
Kankakee River Basin, Indiana

Capability Class & Sub-Class	Grassland Acres Needing Change to Forestland
IIw	215
IIIw	210
IVs	630
IVe	215
VIs	1,290
TOTAL	2,560

The land use adjustments discussed previously have recommended changes from cropland and grassland to less intensive uses such as grassland and forestland respectively. There are 15,560 acres of Class I land now in non-cropland uses which have strong capability for use as cropland, as the need arises. This consists of 8,020 acres of grassland and 7,540 acres of forestland. The net effect of all these changes would be a decrease of 20,340 acres in the total acreage of cropland in the Basin.

The 7,540 acres of forestland on capability Class I land are mostly in small isolated tracts scattered throughout the Basin. Although this is prime agricultural land, it is also good from the standpoint of timber production and offers an excellent alternative of keeping the land in production pending the time it might be needed for additional agricultural production.

3. Effect of Economic Conditions on Landowners and Operators

Numerous factors have had an effect on economic conditions which influence decisions of landowners and operators to apply land treatment. The advance in agricultural technology and associated costs, and the influence of urban expansion (primarily in Lake and Porter Counties) are among the most significant factors.

Technological advances in agricultural crop production have resulted in greater efficiency but at the same time have required significantly higher inputs of capital. Improved varieties of crops, larger machinery, and increased use of fertilizer and chemicals in conjunction with improved management practices have enabled individual farmers to expand production by operating larger acreages and increasing yields. The large capital outlay for a change to new and larger machinery for management practices such as minimum tillage is an obstacle to application of some needed land treatment measures.

Demands for land for urban development have been concentrated in the northern portions of Lake and Porter Counties. The completion of Interstate Highway 65 in the lower portion of the Basin has created some demand for land for residential development in northern Newton and Jasper Counties. Demands for land for residential and commercial development continue to encroach upon the Basin and the Gary-Hammond-East Chicago metropolitan area. Operators of cropland in the urban fringe areas are reluctant to invest in land treatment measures that require a long period of time for benefits to accrue.

Although the demand for land for urban development is increasing at a rate less than the state average, it does have an impact on forest land. Although urbanization may not result in an actual loss in forested acres, it does remove the areas being urbanized from commercial timber production.

As the demand for land-based recreation increases, this too will have an impact on the forestland. A change from timber production to recreational uses requiring open space would have an impact on the acreage available for timber production. This change, however, would create a new source of income for the forestland owners involved. With proper management and selection of types of activities, forestland can be utilized effectively for both recreational purposes and timber production.

Any negative impact on forestland area brings about a corresponding negative impact on wildlife through the reduction or elimination of forest cover and associated habitat. Improved forest and wildlife habitat management can offset some of this direct loss.

B. Floodwater Damage

1. Nature and Extent of Damage

a. Agricultural Damage

The Kankakee River Basin was divided into 35 hydrologic subareas for purposes of identifying water damages by hydrologic units. These areas are identified by major tributaries and by the Conservation Needs (CNI) number as listed in Table V-5 and delineated on Plate 16.

The Basin was inventoried to determine the existence and significance of land and water problems. Flooding along the Kankakee River in Indiana inundates about 106,150 acres (see Plate 17) of which 86,060 acres are cropland. The most significant areas of main stem flooding occur in LaPorte and Starke Counties near its confluence with Robbins Ditch and Yellow River and in Jasper and Lake Counties near Barnard (Hodge) Ditch and Singleton Ditch,respectively. Average annual main stem floodwater damages are estimated to be $1,420,000. About 87 percent of these damages are to crops, pastures, and other agricultural facilities.

The flooding of cropland causes the greatest damage in the form of lost production and reduction in crop quality through delays in farm operations. The most damage occurs from early to late spring rains. Direct crop loss during the summer months is less frequent. In many areas flood damage to crops is associated with high ground water levels in the flood plain soils.

Tributary flood damages in their lower reaches are usually associated with main stem flooding. In the middle and upper reaches of most tributaries, flood damages are not significant and are usually associated with drainage problems. The total area flooded on direct tributaries of the Kankakee in Indiana is about 91,000 acres. Total estimated annual flood damages on these tributaries are $1,234,700, with $1,122,400 occurring to crops and pastures.

TABLE V - 5 AREA FLOODED AND LAND USE-HYDROLOGIC SUBAREAS
Kankakee River Basin, Indiana

CNI Unit	No.	Name	100 Yr. - Area Flooded - Acres Cropland	Grassland	Forestland	Other	Total
28a	1	Upper Kankakee River	11,176	527	1,302	930	13,935
	2	Travis Ditch	73	44	5	122	244
	3	Salisbury Ditch	292	3	3	-	298
	4	Mill Creek-Waltham Ditch	527	115	10	11	663
	5	Robbins Ditch	1,093	50	41	51	1,235
	6	Bailey Ditch	2,549	109	45	42	2,745
	7	Hanna Arm(All Main Stem)					--
	8	Marquardt Ditch	1,013	59	59	47	1,178
	9	Upper Yellow River	2,070	298	217	160	2,745
	10	Lower Yellow River	925	288	630	319	2,162
	11	Craigmile Ditch	3,985	195	85	46	4,311
	12	Pine Creek	1,133	232	113	164	1,642
	13	Pitner Ditch	3,110				3,110
	14	Payne Ditch	590	27	31	22	670
	15	Davis Ditch	125		7	2	134
	16	Cook Ditch	2,725	92	155	78	3,050
	17	Reeves Ditch	3,182	398	159	239	3,978
	18	Crooked Creek-Koselki Ditch	2,536	78	61	9	2,684
	19	Benkie Ditch	999	205	298	42	1,544
	20	Wolf Creek-Sandy Hook Ditch	1,763	202	174	49	2,188
	21	Cornell & Phillips Ditch	1,837	82	70	11	2,000
	22	Breyfogel Ditch	1,995	77	288	632	2,992
	23	Barnard Ditch	2,382	25	42	50	2,499
	24	DeHaan Ditch	1,913	22	164	85	2,184
	25	Knight Ditch	156	3	41	79	279
	26	Beaver Lake Ditch	129	2	59	45	235
	27	Best Ditch	204	14	32	22	272
	28	Singleton Ditch	27,284	418	464	1,358	29,524
	28a	West Creek	1,642	312	251	275	2,480
	28b	Griesel Ditch(in 28)					--
		Sub-total Kankakee Tributaries	77,408	3,877	4,806	4,890	90,981
28a1-	10	Sugar Creek	3,904	60	17	166	4,147
	11	Sugar Creek Tributaries	1,354	18	-	50	1,422
	22	Beaver Creek	440	2	24	22	488
	23	Willow Slough					--
28a1-1		Upper Iroquois River	4,128	1,844	511	1,462	7,945
28a1-2		Lower Iroquois River Tributaries	6,815	1,662	537	2,346	11,360
		Sub-total Iroquois	16,641	3,586	1,089	4,046	25,362
		GRAND TOTAL	94,049	7,463	5,895	8,936	116,343

The Iroquois River tributary has no effect on the Kankakee River in Indiana. The Iroquois valley is entrenched below Rensselaer and floods approximately 19,300 acres, of which a relatively small percentage (57%) is cropland. The tributaries of the Iroquois have localized flood problems, some of which are related to the Iroquois River flood stages. Sugar Creek and Beaver Creek drainage is considered part of the Iroquois tributaries in Indiana. The total area flooded in the Iroquois tributaries in Indiana is about 25,360 acres. Total estimated annual flood damages to crops and pasture in the Iroquois hydrologic subareas are $151,800.

There are 55,970 acres of forestland with a sub-class "w" designation which indicates there are some restrictions to use because of wet soil conditions.

Much of this area is used primarily by wildlife with some minor amounts of recreation use. Restrictions to use in the forest types occurring on the "w" soils are associated with management problems such as timing of harvest and not with species - site problems. The tree species occurring on these sites are adapted to the sites, and would be damaged if the soil-water relationship were altered.

b. Urban-type Damage

Non-agricultural flood damages occur mostly from water-borne debris and sediments which lodge at bridges and in constricted channels, causing bridge damage or diversion of floodwater into adjacent field and roads. Damages to houses and other improvements are sporadic, with some concentration in Plymouth, Sumava Resorts, Rensselaer, Wildwood, Shady Acres, Shelby and Schneider.

Urban type flood damages occur along the Kankakee River in north Newton County and south Lake County. The towns of Schneider and Shelby, located adjacent to the Kankakee River, in south Lake County are subject to flooding. Flood protection is by levees constructed many years ago. Actually, the so-called levees are spoil banks created by construction of Dike Ditch, an excavated channel constructed less than 1/2 mile north of the river but not always parallel with the river. These spoil banks are characteristically of variable top elevation, and little uniformity in cross section. Very little maintenance has been performed and consequently the degree of flood protection varies by location. Flood damage at these towns generally occurs when the levee breaches at a weak or low point during large floods. No statistical frequency of flooding predictions can be calculated due to the unpredictable levee protection.

Flooding at the Kankakee River communities of Shady Acres, Sumava Resorts and Wildwood causes damage to houses, household furnishings, lawns and roads. Some damage occurs annually.

Recently, significant damages occurred in January 1973 and May 1975. These three communities are located within the Kankakee flood plain and adjacent to old river channels. The constructed Kankakee River channel conveys flood flows, but during high stages the floodwater enters the communities through low, weak positions in the spoil banks and by way of old channels that are open to the river. High water lasts for several days. Floods are of long duration and this extended period of high water also causes drainage problems due to the water table rising too near or even above the ground surface.

An engine driven pump at Sumava Resorts is used when necessary to lift water from interior channels into the Kankakee River. The interior drainage channels at Wildwood and Shady Acres are open to the river and pumps are not used at these locations.

2. Frequency and Seasonal Occurrence of Floods

This discussion is based primarily upon precipitation and streamflow data. The flood studies rely particularly heavy upon streamflow data which were available at 24 locations throughout the Kankakee River Basin. Sufficient length of record was available at 22 of these sites for use in statistical analyses. The probability of occurrence of streamflow events was determined. The stream discharge data are taken from Geological Survey, U.S. Department of the Interior publications. Flood mark information was obtained from the Department of Natural Resources, State of Indiana.

Flood frequency is variable depending upon the stream in question and upon the location. Therefore, the following statements indicate the general characteristics for frequency of flooding on selected streams. The data given are for floods which overflow some crop and pasture lands. Generally, floods occur more often than stated upon lower lying lands not used for crops and pasture.

Floods occur about three times per year along the Kankakee River from the Indiana-Illinois State Line upstream to approximately the LaPorte - St. Joseph County Line. Upstream of this county line the Kankakee River overflows on an average of less than once per year. At specific locations spoil banks provide a high degree of flood protection. Cottage properties along the river (predominately in the south Lake and north Newton Counties) incur flooding on the average of once per year.

The Yellow River floods on the average from one to three times per year with the more frequent floods occurring upstream of Plymouth. In the city of Plymouth, flooding occurs on an average of once every three years.

Along the Singleton Ditch in south Lake County flooding is experienced on an average of twice per year. The location and magnitude of flooding are affected by spoil banks.

The frequency of flooding on Iroquois River flood plains averages two to three times per year.

Most tributaries to the above streams experience less frequent flooding than the principal arteries discussed. Flood frequency is inversely proportional to the channel maintenance activity near the location in question.

Seasonal occurrence of flooding was determined by tabulating the month for each recorded flood at several stream gages in the Basin. Reasonably consistent smoother curves of flood probability by month were averaged to find values which have been used in the flood damage analyses. See Table V - 6.

The flood season generally extends from winter through spring. Only 17 percent of all floods along the main stem occur during June through November. Floods along the main streams are the result of long duration rainstorms or the combined effect of more than one rainstorm sometimes occurring over a period of days. Ice jams have been the cause of unusually high stages as have debris accumulations. The contributions to flooding by these two causes cannot be assigned to specific months.

TABLE V - 6. SEASONABLE OCCURRENCE OF FLOODS
Kankakee River Basin, Indiana

Month	Percent of Total Floods	
	Kankakee Main Stem	Tributaries
January	11	12
February	14	14
March	18	16
April	20	14
May	14	11
June	6	10
July	4	8
August	1	3
September	1	2
October	2	2
November	3	3
December	6	5
Total	100	100

3. Significance of Flood Size to Total Flood Problem

The magnitude of experienced floods ranges from catastrophic events down to floods of a minor nuisance. Floods of all sizes contribute to the average annual flood damage value for the Basin. It is apparent that the damage value is much greater in locations where the more frequent floods occur. For example, damages from the one-year and other floods occurring more frequently account for 42 percent of the total average annual flood damages.

C. Drainage

For planning and management purposes, the soils of the Basin are identified as having a dominant hazard of erosion (e), wetness (w), or droughtiness (s). The total Basin area which is predominatly wet is about 1,063,500 acres of which 851,500 acres are in cropland, 62,770 acres are in grassland, 55,970 acres are forest land, and 93,265 acres are in other land use. Wetness is usually considered a problem to management of cropland as discussed above. It is a recognized problem in grassland when pasture management is involved; although, high water table pastures are not prevalent in the Basin. Impaired drainage, whether surface or subsurface, has an adverse effect on crop yields and efficient farm operations. Some of the most serious drainage problems for cropland are associated with the Maumee, Rensselaer, Gilford soil association illustrated on Plate 2.

The Basin was inventoried to delineate those agricultural areas which suffer the most restrictions to farming operations and crop production. These data were correlated with the 1968 USDA Conservation Needs Inventory. About 851,500 acres, or 45 percent of the Basin, have seasonal problems of excess water. Areas with impaired drainage are well distributed throughout the Basin. Many such areas are also subject to flooding. The total identified joint flood-impaired drainage areas involve about 222,500 acres.

Field studies were conducted to determine needs to correct the impaired drainage. Increased production through more efficient use of existing cropland can be achieved by installation of drainage measures. This increased efficiency would be accomplished by enabling farmers to use more intensive practices including increased use of row crops, fertilizers, and weed and insect control.

The type of drainage improvements needed on cropland include subsurface drainage and open ditch installation on 439,350 acres and improvement of existing outlets for 180,000 acres. In the many areas with high water tables, water management measures are needed. Water level control structues have been installed in several open ditches, and with proper management of pumps and gates, they effectively control the water levels in relation to the crops grown.

The need for drainage is not critical on the wet forest land areas. The species occurring on these soils are adapted to this condition and a change in seasonal high water tables brought about through drainage would have a detrimental impact on this resource. Many of these "wet" forest stands occur in depressional areas and "swampy" situations which act as natural filters for water flowing into or through them. A reduction of this natural filter system would permit more sediment to reach the water courses.

D. Erosion Problems

Soil erosion is one of the problems relating to the proper and efficient use of the land resources of the Basin. Excessive erosion reduces the capability of the land to produce crops and results in a general deterioration of the land resource base. The soil erosion process also represents the source of sediment that causes additional damage to land, open ditches, channels, and roads. In excessive concentrations, sediment has a detrimental effect on the quality of surface water in streams and lakes.

Approximately 15 percent 1/ (260,770 acres) of the Basin has a dominant hazard or problem 2/ of soil erosion. A total of 188,890 acres of cropland have a dominant erosion problem or hazard and only 17,770 acres may be characterized as having a current erosion problem and a corresponding need for erosion control treatment. Table V-1 illustrates the distribution of erosion hazard soils among the various land uses. There are no widespread erosion problems on the grasslands under the present use; however, some of these areas would be susceptible to serious erosion under more intensive use, such as cropland.

There are several types of soil erosion in the Basin; however, the frequent, intense thunderstorm rainfall occurring in a region with such a large percentage of cropland establishes sheet erosion as the most widespread and severe. Soils are described as having an erosion problem when the losses result in a depletion of the soil resource. The maximum amount of soil loss that can be tolorated without depleting the resource for continued agriculture production is referred to as the soil loss tolerance and is usually expressed in tons per acre per year. Most of the erosion hazard soils within the Basin have soil loss tolerances ranging from 3 to 4 tons per acre annually. Computations of sheet and rill erosion in the Kankakee Basin reveal an average annual soil loss of 1.2 ton per acre. Cropland erosion within the Basin averages about 1.6 tons per acre; pastureland averages about 0.1 ton per acre annually. Approximately 227,500 acres of cropland (13 percent of the Basin) have soil losses in excess of 3 tons per acre annually (6.4 tons per acre average annual) and accounts for 65 percent of the total soil loss (gross erosion) in the Basin. Another 129,300 acres of cropland (7 percent of the Basin) have an average annual soil loss of between 2 and 3 tons per acre. However, 80 percent of the soil loss (gross erosion) occurs on about 20 percent of the Basin land. The

1/ Conservation Needs Inventory - 1968
2/ Susceptibility to erosion is the dominant problem or hazard in the use of the soils. Erosion susceptibility and past erosion damage are the major factors for placing soils in this category.

average rate of soil loss from this area is approximately 5 tons per acre annually. The bulk of this erosion occurs on the more sloping land along the northern and eastern periphery of the Basin. Conservation treatment is needed to reduce the soil loss from these areas. The soil loss values described above are determined on the basis of average management practices taking into consideration the rainfall erosion potential, soil type, and the gradient and length of slope.

Although there are 22,960 acres of forest land on soils with erosion hazards, the average annual erosion rate for the forest land in the Basin is 0.1 ton per acre. This indicates that erosion on forest land is negligible at the present time. Proper forest management and protection from fire, insects, and grazing will maintain this good condition.

One factor that accounts for the relatively low average soil loss is the high percentage of soils which have relatively flat slopes and low runoff potential. Approximately 44 percent of the Basin soils are characterized by very gentle slops and low runoff (high infiltration) potential.

Wind erosion is a potentially severe problem on approximately one-fourth (445,000 acres) of the Basin soils. About 63 percent of this area (280,000 acres) is currently in cropland and is most susceptible to wind erosion. The most serious damage from wind erosion is the separation and gradual removal of silt, clay, and organic matter from the surface soils; often leaving sandy and relatively infertile materials. In addition, soil blowing may cause damage to crops. Some crops such as onions, spinach, carrots, and cucumbers have very little tolerance to wind erosion and may be destroyed in a very short time by abrasion from wind-blown soil particles. The deposition of blowing soil can cause additional damage by filling drainage ditches, blocking farm lanes, and burying fences. The most erodible soils are the very fine, fine, and medium grained sands.

Soil management techniques are needed to control the potential wind erosion problems. The use of vegetative cover and crop residue is one of the most effective means of controlling wind erosion. Plant residues help anchor the topsoil particles, improve soil structure, reduce wind velocity at the soil surface, and improve infiltation of water. This is accomplished by leaving crop residues such as corn-stalks or soybean stubble on the soil surface during the severe erosion period in winter and spring. Field windbreaks are effective in controlling wind erosion and have additional advantages of enhancing wildlife habitat, reducing wind speed, conserving moisture, and protecting crops.

Gully erosion, although locally a serious problem, is not a major problem widespread throughout the Basin. Questionnaires completed by local conservationists indicate that severe gully problems are restricted to local, widely scattered areas, and that potentially moderate gully erosion problems are limited to a very small portion of the Basin soils.

Streambank erosion is not a widespread or severe threat to the productive land base of the Basin, due partly to relatively low velocities of the Kankakee River and major tributaries. Some streambank erosion does occur locally on some of the Basin streams. However, in general, streambank erosion is not severe enough to warrant further study pertaining to possible treatment measures such as riprap or grade control structues.

Erosion damage from flood plain scour is minimal in this Basin. The relatively low flood flow velocities and the lack of well-defined and confined flood plains results in low out-of-bank flow velocities and consequently, the opportunity for widespread scour is not great. Nevertheless some scour does occur in local areas.

Erosion is a severe problem on new construction areas, on livestock feedlots, and on unvegetated roadside banks and ditches. Disturbed and non-vegetated areas that are cleared and graded for urban and commercial developments are particularly subject to severe erosion. Control of erosion on those areas is needed.

E. Sediment Problems

In addition to the erosion problems outlined above, the resulting sediment creates additional problems. Suspended sediment in the form of fine silts and clays creates a turbidity of the water which reduces the aesthetic quality of the water, decreases its value for recreational purposes, and may have an adverse effect on fish and wildlife. The deposition of the suspended load or bed load material also causes additional damage such as the filling of stream channels.

The sediment problems in the Kankakee River Basin, although present, are not as severe as in some adjoining areas. Suspended sediment records are available for only two locations within the Basin. The average annual suspended-sediment discharge as reported by the U.S. Geological Survey 1/ for the Kankakee River at Shelby, Indiana, is 75 tons per square mile; 97 tons per square mile for the Iroquois River at Foresmen, Indiana. This compares with 209 tons per square mile for the Wabash River at Bluffton, Indiana, and 52 tons per square mile for the Tippecanoe River at Ora, Indiana. The Kankakee River suspended load values are among the lowest of 35 Indiana stations which were reported in the U.S. Geological Survey report.

1/ Johnson, L.E. 1971, Continuing Sediment Investigations in Indiana, U.S. Dept. of Interior, Geological Survey, Open file report, Indianapolis.

The relatively low sediment yield in the Kankakee River Basin can be partially explained by a number of factors including the topography, stream flow characteristics, and soils of the Basin. Gentle slopes and pervious soils cause a larger percentage of precipitation to infiltrate the soil which results in less direct runoff, lower velocities of stream flow, and lesser capability of the stream flow to pick up and transport the sediment particles. The Kankakee Basin, by virtue of a relatively large percentage of gentle slopes and pervious soils, is characterized by streams with relatively low flow velocities and low flood stages and thus, less capability to transport the sediment loads. Additionally, during periods of base runoff when the streamflows are maintained largely by ground water effluent, the sediment concentrations are low and change little from day to day. Therefore, low sediment concentrations in the Basin can be partially attributed to the fact that a very substantial portion of the annual Kankakee River Basin streamflow is from ground water sources.

Sediment production, or yields, (that portion of the basic erosion rate which actually reaches a live stream) from forest land is insignificant. The basic erosion rate, or amount of soil particles displaced, is extremely low and the filtering action of ground cover under the forest stands keeps this displaced soil close to its source. Thus, although some soil particles are moved, they are quickly trapped by the litter on the soil surface and do not leave the area in the form of suspended sediment.

Despite the low sediment yield, the Basin is not totally free of sediment problems and associated damages. There are locally significant damages which result from the accumulation of sediment in channels thus reducing the capacity of the channel to carry runoff and increasing the possibilities of flooding. Sediment accumulations in channels have blocked some tile drain outlets and surface drainage ditches and have caused a general raising of the water table in adjacent land. The need is for adequate land treatment and proper maintenance of existing channels. Evaluation of direct monetary damage from increased maintenance due to channel filling has not been attempted. This type of damage is very closely related to floodwater damages and to drainage problems which were discussed in preceeding pages. The joint floodwater damages and drainage problems may be attributed in part, in some locations, to sediment accumulation in stream channels.

F. Irrigation

Irrigation in the Kankakee Economic Area is not a very significant crop production practice when the acreage irrigated is compared to the total cropland acreage. In 1969, approximately 75 farm operators in the Basin utilized irrigation on 16,800 acres of cropland. By 1990, irrigated cropland in the Economic Area is expected to increase to 29,200 acres and by 2020 to 46,700 acres. The increases are expected to occur mostly on sandy and well-drained muck soils on

which a majority of the truck and specialty crops will be grown. These soils are considered to be best adaptable to methods of sprinkler and subsurface irrigation.

Weather conditions in the Basin are such as to create the assumption that irrigation could be beneficial to more acres of crop production. Weather causes droughty conditions in some years, and supplemental irrigation during these periods would be a profitable practice. However, during most years the rainfall is adequate and supplemental irrigation could result only in a small increase in crop yields.

From a national viewpoint the development of irrigation is not necessary for the Kankakee River Basin to produce its share of projected food and fiber demands. However, irrigation of some specialty and field crops is expected to continue during the projection time period.

G. Present and Projected Water Use and Water Quality

1. Muncipal and Industrial Water Use and Projected Needs

a. General Statements

There are 28 communities in the Indiana portion of the Kankakee River Basin which have public water supplies providing water for domestic, commercial, and industrial purposes. These municipally supplied communities range in population from rural Schneider, population approximately 400, to urban South Bend, population approximately 126,000. Recent water use figures range from 19 to 217 gallons per capita per day (gpcd) with a median of approximately 96 gpcd. Each municipality utilizes ground water as the current source of water for the populus, and certain of the municipalities having potential access to surface water source, if required.

Industry in the Kankakee River Basin is concentrated almost exclusively in the communities of Bremen, Crown Point, Knox, LaPorte, Remington, and South Bend. Recorded data of the public water supplies in the Basin show that these particular communities have higher per capita water usage than those principally rural in nature. To this extent, communities were treated differently and different projection methods applied. The projected figures reflect the water demand for the included municipalities. These values represent increases from 6 to 76 percent over the 1970 per capita water usage figures, with the increase depending on each municipality's degree of industrialization.

Valparaiso obtains a portion of its water supply from well fields located within the Kankakee River Basin. The 1968 water usage was approximately 2.5 million gallons per day (average daily use). Because the corporate limits of Valparaiso are not within the Basin, projections of future water demands are not included in this report.

The method used to project municipal-industrial water demands in the Kankakee River Basin consisted of (1) categorizing basin communities as being industrailized or non-industrialized, (2) breaking down the pumpages into domestic-commerical and industrial components, (3) making assumptions based upon historical data and expected trends, and (4) using these assumptions to project component water demand in each category. These assumptions were that the domestic-commercial pumpage increased at the rate of one gallon per capita per day per year and the industrial pumpage increased at the rate of one percent per year. The degree of industrialization of a community was considered to be a critical factor because industrailized communities have characteristically higher per capita water usage demands than non-industrailized communities of comparable population. The parameter of water recycling was forecast to significantly affect the water demand projection in the later years of the projection period.

b. Discussion of Specific Communities

Tables V-7 and V-8 show recent and projected population, gross water pumpage, and per capita water use for industrial and non-industrialized communities, respectively. In examining the gross water pumpage projections, two items should be noted. First, the gross water pumpage figures represents the demands from natural sources and not the total water usage. Total water usage is defined as the total amount of water used for domestic-commerical and industrial purposes, including the use of recycled water. Second, the water demand projections beyond the year 1990 were expected to be influenced by an increase in the amount of water being recycled; hence recycling is expected to cause a diminishment in the rate of increase in water demand beginning near the year 1990. A general relationship depicted by these tables is that communities with large populations generally have a higher per capita water usage than communities of smaller populations. This is evident when comparing the pumpage data at LaPorte and South Bend to those of Argos and Hebron.

In applying the methodology, it was found that the pumpage data from communities of Kingsford Heights and Westville are erratic through the period of time for which records have been kept. Kingsford Heights in one decade experienced a pumpage increase of almost 200 percent. Because of this erratic and inadequate data, no projections were made of this municipality.

A study of the water supplies for all of the communities in the Kankakee River Basin indicates that ground water supplies are capable of meeting projected needs.

TABLE V - 7. RECENT AND PROJECTED POPULATION, GROSS WATER PUMPAGE AND PER CAPITA WATER USE DATA FOR INDUSTRIALIZED COMMUNITIES WITH PUBLIC WATER SUPPLIES 1/
Kankakee River Basin, Indiana

Community	1970	1990	2020
Bremen			
Population	3,487	4,000	4,900
Gross pumpage, mgd	0.666	0.828	1.127
Per capita usage, gpcd	172.0	207	230
Crown Point			
Population	10,931	14,600	19,500
Gross pumpage, mgd	1.129	2.146	3.276
Per capita usage, gpcd	103.0	147	168
Knox			
Population	3,519	3,900	4,100
Gross pumpage, mgd	0.379	0.495	0.603
Per capita usage, gpcd	107.7	127	147
LaPorte			
Population	22,140	23,000	24,000
Gross pumpage, mgd	4.537	4.830	5.520
Per capita usage, gpcd	205.0	210	230
Remington			
Population	1,127	1,300	1,500
Gross pumpage, mgd	0.245	0.299	0.345
Per capita usage, gpcd	217.5	230	230
South Bend			
Population	125,580	130,200	131,500
Gross pumpage, mgd	20.500	23.566	26.563
Per capita usage, gpcd	163.2	181	202

1/ Provided by the State Water Plan Section, Indiana Department of Natural Resources. Base data from the Indiana State Board of Health.

TABLE V - 8. HISTORIC AND PROJECTED POPULATION, WATER PUMPAGE AND WATER USE DATA FOR NON-INDUSTRIAL COMMUNITIES WITH PUBLIC WATER SUPPLIES 1/
Kankakee River Basin, Indiana

Community	1970	1990	2020
Argos			
Population	1,393	1,400	1,500
Gross pumpage, mgd	0.089	0.118	0.149
Per capita usage, gpcd	63.8	84	99
Brook			
Population	919	900	1,000
Gross pumpage, mgd	0.057	0.078	0.100
Per capita usage, gpcd	67.0	87	102
Earl Park			
Population	478	500	500
Gross pumpage, mgd	0.022	0.033	0.041
Per capita usage, gpcd	46.0	66	81
Fowler			
Population	2,643	2,800	3,100
Gross pumpage, mgd	0.232	0.302	0.381
Per capita usage, gpcd	87.7	108	123
Goodland			
Population	1,176	1,200	1,200
Gross pumpage, mgd	0.102	0.128	0.146
Per capita usage, gpcd	86.9	107	122
Hamlet			
Population	761	800	900
Gross pumpage, mgd	0.036	0.054	0.074
Per capita usage, gpcd	47.3	67	82
Hebron			
Population	1,624	1,900	2,200
Gross pumpage, mgd	0.082	0.135	0.189
Per capita usage, gpcd	50.5	71	86
Kentland			
Population	1,864	1,900	2,100
Gross pumpage, mgd	0.213	0.255	0.313
Per capita usage, gpcd	114.2	134	149
Kingsford Heights			
Population	1,200	1,300	1,400
Gross pumpage, mgd	0.253	-	-
Per capita usage, gpcd	211.0	-	-

1/ Provided by the State Water Plan Section, Indiana Department of Natural Resources. Base data from the Indiana State Board of Health

TABLE V-8 - continued
Kankakee River Basin, Indiana

Community	1970	1990	2020
Kouts			
Population	1,388	1,600	1,900
Gross pumpage, mgd	0.083	0.128	0.180
Per capita usage, gpcd	59.8	80	95
LaCross			
Population	696	700	800
Gross pumpage, mgd	0.032	0.046	0.065
Per capita usage, gpcd	45.9	66	81
Lakeville			
Population	712	800	900
Gross pumpage, mgd	0.076	0.102	0.128
Per capita usage, gpcd	106.7	127	142
Lowell			
Population	3,839	4,900	6,400
Gross pumpage, mgd	0.403	0.612	0.896
Per capita usage, gpcd	105.0	125	140
Morocco			
Population	1,285	1,300	1,300
Gross pumpage, mgd	0.102	0.128	0.148
Per capita usage, gpcd	79.4	125	140
New Carlisle			
Population	1,434	1,900	2,400
Gross pumpage, mgd	0.124	0.201	0.290
Per capita usage, gpcd	86.4	106	121
North Judson			
Population	1,738	1,800	2,100
Gross pumpage, mgd	0.128	0.169	0.228
Per capita usage, gpcd	73.7	94	109
North Liberty			
Population	1,259	1,400	1,500
Gross pumpage, mgd	0.058	0.092	0.122
Per capita usage, gpcd	46.1	66	81
Plymouth			
Population	7,661	8,200	8,800
Gross pumpage, mgd	1.054	1.238	1.460
Per capita usage, gpcd	131.4	151	166
Rensselaer			
Population	4,688	5,100	5,700
Gross pumpage, mgd	0.527	0.673	0.838
Per capita usage, gpcd	112.3	132	147

TABLE V-8 - continued
Kankakee River Basin, Indiana

Community	1970	1990	2020
Schneider			
Population	426	500	700
Gross pumpage, mgd	0.041	0.058	0.092
Per capita usage, gpcd	96.2	116	131
Walkerton			
Population	2,006	2,400	2,700
Gross pumpage, mgd	0.210	0.298	0.375
Per capita usage, gpcd	104.3	124	139
Westville			
Population	2,614	3,000	3,600
Gross pumpage, mgd	0.049	0.213	0.310
Per capita usage, gpcd	18.8	71	86

2. Rural Water Use and Projected Needs

Water is utilized in the rural sector of the Economic Area for many purposes including domestic uses, irrigation, livestock consumption, sanitation, crop spraying, and insect control.

There are no accurate records available on rural water uses. The quantity of water used has been estimated from secondary data relating to population, livestock numbers, crop acreage, and estimated water requirements. Present and projected rural water requirements and consumptive use are shown in Table V-9. The widespread availability of generally acceptable quality ground water explains the dependence upon ground water as probably the most important source of rural water needs.

a. Rural Domestic

The rural domestic water requirements are based upon rural population and a per capita use rate. The rural population considered for this determination consists of the total population of the Economic Area less the total population supplied by municipal water systems. A use rate of 60 gallons per capita day (gpcd) was assumed for the 1970 population and increased to 75 gpcd for the year 2020. Rural domestic water requirements are projected to increase significantly from about 4.7 millions of gallons per day (mgd) in 1970 to 8.0 mgd by 2020.

Ground water has been the principal source for rural domestic use and it appears that nearly all of the future needs will be supplied from this source of supply. Rural water systems in the area are not in great demand because of the widespread availability of ground water. With the possible exception of relatively small scattered areas, ground water sources are expected to be adequate to meet the projected rural domestic demands.

TABLE V - 9. RURAL WATER USE AND PROJECTED REQUIREMENTS
Kankakee River Basin (Economic Area), Indiana

	Requirement			Consumption 2/		
	Present 3/	1990	2020	Present 3/	1990	2020
	Values in millions of gallons per day (mgd)					
Rural Domestic 1/	4.7	6.3	8.0	3.5	4.7	6.0
Livestock	6.7	10.3	14.3	6.0	9.3	12.9
Irrigation	13.2	29.5	48.2	10.6	22.1	36.2
Total	24.6	46.1	70.5	20.1	36.1	55.1

1/ Does not include communities that have central water service.
2/ Consumptive use or that portion of the water withdrawn that is no longer available due to loss either through evaporation or transpiration or otherwise removed from the study area's environment.
3/ Irrigation data is 1967 base; others are 1970 base.

b. Livestock

The present and future needs for livestock water are dependent on existing and projected livestock numbers. Water use requirements and consumptive rates were developed for various livestock categories and adjusted for the projection periods. The requirements for the Basin are estimated to increase from 6.7 mgd in 1970 to about 14.3 mgd by 2020. Consumptive use rates are estimated to increase from 6.0 mgd in 1970 to 12.9 mgd by the year 2020 (see Table V-9).

Ground water and surface water sources are both utilized to meet the livestock water requirements. Numerous ponds within the Basin serve the principal purpose of storage for livestock water. The generally widespread availability of acceptable quality ground water is conducive to its use for livestock water. Both surface and ground water sources will continue to be important in satisfying the livestock water requirements.

c. Irrigation

The requirements for irrigation water in the Basin are relatively minor in comparison to the total rural water use and projected needs as shown on Table V-9. Future irrigation water needs are expected to occur mostly on sandy soils and well-drained muck soils which are well-suited to sprinkler or subsurface irrigation systems. The water requirements are expected to increase from 13.2 mgd in 1967 to 29.5 mgd (33,000 acre-feet annually) in 1990, and 48.2 mgd (54,000 acre-feet annually) by the year 2020. The increased acreage of irrigation is expected to occur in areas with suitable soils and adequate supplies of ground water.

Water Quality Problems in Streams

a. General

There are many point and non-point discharge sources which contribute to the pollution of waterways within the Kankakee River Basin. These sources are municipal wastewater, agricultural (confined feeding operations and fertilizer and pesticide run-off), pesticide and insecticide (spraying operation), septic tanks, sanitary landfills, salt storage areas, industrial wastewater, and haulers of chemical and petroleum products.

Twenty-three incroporated muncipalities in the Basin have recognized sewer systems. Nineteen of these provide sewage treatment; all are secondary facilities.

The three municipalities in the Basin with sewers which do not provide sewage treatment are as follows: Earl Park, Brook, and Morocco. The municipalities of DeMotte, Wheatfield, Schneider, LaCross, Wanatah, Pine Lake, LaPaz, Goodland, Mount Ayr, and Hamlet are without sewers. Table V-10 lists the municipal wastewater treatment needs for the Basin.

There are presently approximately 66 semi-public waste disposal facilities located within the Kankakee River Basin. The distribution (by county) of these facilities are as follows:

Benton County	(1)
Lake County	(33)
LaPorte County	(8)
Marshall County	(3)
Newton County	(3)
Porter County	(18)

These facilities are regulated and periodically inspected to insure satisfactory operation and proper treatment.

There are 36 agricultural feedlot 1/ facilities presently in operation within the Kankakee River Basin. These operations include poultry; finishing, farrowing sows and nursery hogs; and dairy and beef cattle. The distribution (by county) of these feedlot operators are summarized as follows:

Benton County	(11)
Jasper County	(6)
Lake County	(2)
LaPorte County	(4)
Marshall County	(8)
Newton County	(4)
Porter County	(1)

The number of these operations is continually increasing, and therefore, additional manpower will be required by the State Board of Health if proper surveillance is to be maintained for continued protection from this type of pollution.

There are no significant industrial wastes being discharged to the streams of the Kankakee River Basin.

1/ Feedlots under jurisdiction of the Indiana Confined Feeding Law.

TABLE V - 10. MUNICIPAL WASTEWATER TREATMENT NEEDS: INDIANA WATER QUALITY STANDARDS
Kankakee River Basin, Indiana

Municipality	Treatment Need
Bremen	Expansion infiltration control
Brook	Sewage treatment facilities
DeMott	Sewage treatment facilities
Earl Park	Sewage treatment facilities
Goodland	Sewage treatment facilities
Hamlet	Sewage treatment facilities
Hebron	Advanced waste treatment
Kentland	Advanced waste treatment
Kingsford Heights	Advanced waste treatment
Kouts	Advanced waste treatment
LaCross	Sewage treatment facilities
Lakeville	Chlorination
Lapaz	Sewage treatment facilities
LaPorte	Advanced waste treatment
Morocco	Sewage treatment facilities
Mount Ayr	Sewage treatment facilities
Pine Lake	Sewage treatment facilities
Remington	Advanced waste treatment
Rensselaer	Additional sanitary sewers and expansion
Schneider	Sewage treatment facilities
St. John	Sewage treatment facilities or connection to Schererville
Wheatfield	Sewage treatment facilities
Walkerton	Sewage treatment facilities
Wanatah	Sewage treatment facilities

b. Effects of Runoff from Agricultural Land

The potential deterioration of water quality in streams and lakes due to rural sources is complex and varied. These sources may include runoff from cultivated land, feedlots, and individual homesteads. The latter category may contribute directly or indirectly, through ineffective septic systems or through the discharge of sewage. The relative impact of each of these sources in a given area depends on a host of factors.

Runoff from cultivated land may effect water quality through: (1) the discharge of sediment (sedimentation and turbidity problems) and sediment borne pollutants (nutrients and

pesticides) and (2) through the discharge of dissolved pollutants in runoff water. Nutrient removal by runoff varies considerably depending on topography, hydrologic conditions, fertilizer and management practices, and the geochemical properties of the prevalent soil. No systematic study of the relative influence of each of these factors on the nutrient content of runoff has been conducted; although extensive information is available in regard to the expected soil losses under various conditions.

In view of the relative minor variation in relief within the Kankakee River Basin, one might assume nutrient enrichment of open water by runoff to be of minor significance. In fact, suspended load values as measured for a number of years in the Kankakee River at Shelby, Indiana, near the Illinois-Indiana border are rather low (1-96 parts per million -(ppm) during the period 1968-1970, according to "Indiana Water Quality", Indiana State Board of Health and Stream Pollution Control Board). Phosphate levels at this station varied from 0.1 to 2.1 ppm during this period with the majority of the data points around 0.2 ppm. Nitrate levels (reported as nitrogen) at this location ranged from 0.2-4.8 ppm with an average of 1.5 ppm. These relatively low sediment and nutrient levels cited refer to the combined load discharged by urban, suburban and rural districts. No breakdown has been made as to the relative contribution of each source. It would seem, therefore, that runoff from cultivated land might be, at the most, a contributing factor to nutrient enrichment of streams, particularly in the watersheds of the upper tributaries to the Kankakee River where surface relief is more pronounced.

4. Ground Water Quality Problems

Table III-10 indicates that the quality of ground water that serves as the source for municipal supplies in 27 Basin communities is generally acceptable with the exception of moderate hardness and the presence of iron and manganese. Proper treatment can improve the quality to overcome objections and meet the Public Health Service Drinking Water Standards. The degree of treatment provided varies among the individual communities and reflects, to some degree, the communities interpretation of their water quality problems. As noted from Table III-10, the Argos, Hebron, LaCross, Morocco, Rensselaer and Walkerton supplies have been made more acceptable by softening and iron removal treatment. Bremen, Fowler, Kingsford Heights, Knox,LaPorte, Lowell and South Bend have also provided iron removal treatment. LaPorte, Morocco, New Carlisle, Rensselaer, South Bend and Walkerton standardize the fluoride content of their water between 1.0 and 1.5 milligrams per liter as part of a program to reduce dental caries. Goodland has provisions for hydrogen sulfide removal.

The water supplies of 12 communities are untreated except for chlorination. These towns have chosen not to sophisticate their water by treatment to reduce the iron, even though the iron content is higher than the Public Health Service Drinking Water Standards. Several water supplies also exceed the standard for manganese in drinking water.

Ground water in the communities without public water supply systems and in the rural areas generally is moderately hard and contains appreciable amounts of iron, some manganese, and even hydrogen sulphite in isolated areas. These elements, although not necessarily harmful to humans, are undesirable from an aesthetic viewpoint and can be reduced by adequate treatment.

H. Recreation

1. Availability of Existing Resources to the General Public

Access to recreation resources is available on designated recreational land and water areas. An inventory of these areas, shown in Table IV-17, indicates their distribution is such that they are readily accessible to residents within the region in which they reside. Additional non-designated existing recreational resources have varying degrees of access which are dependent upon owner attitudes. These non-designated areas are not considered stable sources for recreation because their availability may change at any time.

2. Needs for Additional Recreational Development

a. Relation of Present and Future Population to Needs for Additional Development.

The Economic Area presently has a population of about 1.1 million which is expected to increase to over 1.9 million by the year 2020. Future projections do not indicate a large change in population distribution between urban and rural. Urban population is expected to increase from about 81 percent to about 87 percent. Table IV-2 shows the relationship between urban and rural population in the area.

Recreation facilities must be patterned to meet the needs of the population. As population increases and changes between urban and rural occur, the type of recreational facilities required will also be altered. Recreational facilities that are more intensively developed are generally planned as population density and intensity of land use increases.

The need for recreational facilities is determined by an analysis of the population resources and their related socio-economic factors pertaining to recreation. Urban-rural distribution, age, income levels, education, type of employment, social status, leisure time, and travel habits are some of the factors which affect participation in any given activity. Availability and quality of both resources and facilities is also an important factor. These factors and their effect must be determined in order to predict future demands for various types of recreational facilities.

Ownership of recreational land and water areas affects the amount and type of recreational facilities available. As population and related recreational demands change, ownership of some potential recreational resources may need to be changed from private to public. An inventory of existing recreational land and water areas indicated a total of 47,473 acres are administered by public agencies while 11,453 acres are administered by non-public agencies but for general public use. (See Table IV-17).

Existing data on the number of people outside the area utilizing recreational facilities in the area are not available to establish a trend. Also, adequate data are not available on people living in the area that go outside the area for recreational activities. Reports have indicated that a large percentage of people utilizing recreational facilities within the area live in the area. Therefore, no allowance has been made for recreational demand that would result from persons living outside the area. All of Benton, Jasper, Lake, LaPorte, Marshall, Newton, Porter, Starke, and St. Joseph Counties are included in the current and future recreational facilities, demands, and needs.

Sixteen recreational activities were considered in the study. These include picnicking, camping, golfing, snow skiing bicycling, horseback riding, hiking, nature walks, playfields, driving for pleasure, swimming, fishing, boating (except sailing), water skiing, canoeing, and hunting. The demand for each of these recreational activities is determined by computing a participation rate for that activity.

Participation rates used in this study are 1973 rates from the Indiana Department of Natural Resources, Division of Outdoor Recreation, adjusted from Planning and Development Regions to the area by a weighted average based on the population for each time period. These rates are shown in Table V-11.

Demand projections for each of the 16 recreational activities are expressed as activity days. Activity day is defined as a statistical unit of recreation use by one person in pursuit of a single activity for all or part of one 24-hour period.

The recreational activities are divided into two categories, land based and water based activities. Land based activities consist of driving for pleasure, picnicking, camping, golfing, snow skiing, playfield, bicycling, horseback riding, hiking, nature walking, and hunting. Water based activities consist of swimming, fishing, canoeing, boating (except sailing), and water skiing. Table V-11 shows the present and projected demands for land and water based recreational activities.

b. Standards

Recreation standards are used to relate supply to demand for recreational facilities. Limited resources and capital at times make it impossible to attain certain standards that are necessary to maintain quality recreational facilities.

Standards used for the area are from the Indiana Outdoor Recreation Plan (1970), Shaping The Future.

1. Standards for land and water based recreational activities. Table V-12 lists the standards used for each recreational activity considered in the area. These standards do not represent the optimum condition, but an acceptable standard for a quality recreational experience.

2. Driving for pleasure

   It is difficult to equate demand to supply for this activity. Therefore, a standard has not been used for this activity. Road standards, zoning, maintaining existing visual assets, and other factors including the available supply of gasoline have an effect on this activity.

c. Needs

The recreational needs for the Economic Area were developed using the relationship between the demand projections, assumed standards, and existing supply of acreage and facilities for each specific activity. These needs represent the additional land and water area required to satisfy the outdoor recreational demands.

Projection of recreational needs for the area assumes that resources are available and facilities will be provided. However, if resources are not available or facilities provided, one or more of the following can be expected to occur: (1) part of the demands would be shifted to adjacent areas; (2) a change to other outdoor recreational activities; (3) projected demand may decrease to reduce overcrowding; or (4) part of the demand may be changed to indoor recreational activities;

TABLE V-11 PRESENT AND PROJECTED DEMANDS FOR LAND AND WATER BASED RECREATIONAL ACTIVITIES
Kankakee River Basin (Economic Area), Indiana

Activity	Existing Activity Days (1970) 1/	1970		1980		1990		2000		2010		2020	
		Rate 2/	Demand 3/	Rate 2/	Demand 3/	Rate 2/	Demand 3/	Rate 2/	Demand 3/	Rate 2/	Demand 3/	Rate 2/	Demand 3/
Land Based													
Driving for Pleasure		2.10	2269.7	2.10	2558.1	2.11	2892.8	2.11	3255.2	2.11	3658.0	2.12	4106.9
Picnicking	4692.1	3.71	4011.7	3.71	4519.9	3.72	5107.0	3.72	5744.9	3.73	6451.7	3.73	7241.0
Camping	648.0	3.14	3399.6	3.14	3821.4	3.14	4307.6	3.13	4834.2	3.13	5419.4	3.13	6068.1
Golfing	725.5	0.72	782.7	0.72	881.1	0.72	993.1	0.72	1114.4	0.72	1250.5	0.72	1400.0
Snow Skiing	135.0	0.05	51.9	0.05	57.2	0.05	64.6	0.05	72.5	0.05	81.4	0.05	91.3
Playfields	1586.4	2.63	2841.7	2.63	3200.7	2.63	3615.3	2.63	4065.6	2.64	4563.8	2.64	5120.5
Bicycling	0	1.21	1309.5	1.21	1477.4	1.22	1670.3	1.22	1991.1	1.22	2114.8	1.22	2374.8
Horseback Riding	112.6	0.73	786.1	0.73	884.8	0.73	998.6	0.73	1122.1	0.73	1259.2	0.73	1411.7
Hiking	38.0	2.19	2362.7	2.19	2662.8	2.19	3009.6	2.19	3386.4	2.20	3805.2	2.20	4272.0
Nature Walks	0	2.11	2281.6	2.11	2570.3	2.12	2907.9	2.12	3273.8	2.12	3678.8	2.13	4132.2
Hunting	147.1	0.85	922.4	0.85	1038.1	0.85	1173.1	0.85	1318.1	0.85	1479.1	0.85	1658.3
Water Based													
Swimming	1584.0	3.58	3868.9	3.57	4338.7	3.55	4880.4	3.54	5467.1	3.53	6119.2	3.52	6839.0
Fishing	2253.6	1.36	1469.5	1.36	1655.1	1.36	1872.2	1.37	2106.9	1.37	2365.9	1.37	2656.4
Canoeing	0	0.41	443.3	0.41	499.0	0.41	563.2	0.41	632.8	0.41	710.1	0.41	796.1
Boating 4/	753.3	1.52	1642.5	1.52	1851.1	1.52	2093.4	1.53	2355.4	1.53	2646.5	1.53	2971.0
Water Skiing	105.7	0.58	622.8	0.58	702.2	0.58	793.9	0.58	893.7	0.58	1004.6	0.58	1128.2

1/ Available activity days (thousands) based on existing facilities and standards for recreational activities.
2/ Seasonal recreation participation rates. Rates are number of occasions of participation by all ages of the population.
3/ Activity days (thousands)
4/ Does not include sailing.

TABLE V - 12 STANDARDS FOR LAND AND WATER BASED RECREATIONAL ACTIVITIES 1/
Kankakee River Basin, Indiana

Activity	Unit	Standard
Land Based	Daily	
Picnicking	Capacity/Acre	200 - Urban
		96 - Suburban
		64 - Rural
	Tables/Acre	20 - Urban
		12 - Suburban
		8 - Rural
Camping	Daily Capacity/Acre	36
	Campsites/Acre	9
Golf	Daily Capacity/ Hole	27.3
	Acres/Hole	8.5
Snow Skiing	Daily Capacity-Persons/Slope	150
	Acres/Slope	2.5
Playfields	Daily Capacity/Field	140 - Urban
		200 - Suburban
		200 - Rural
	Acres/Field	5 - Urban
		10 - Suburban
		10 - Rural
Bicycling	Daily Capacity/Mile of Trail	800 - Urban
		300 - Suburban
		200 - Rural
Horseback Riding	Daily Capacity/Mile of Bridle Trail	80 - Urban
		40 - Suburban
		40 - Rural
Hiking	Daily Capacity/Mile of Trail	240 - Urban
		120 - Suburban
		60 - Rural
Nature Walks	Daily Capacity/Mile of Trail	320 - Urban
		240 - Suburban
		160 - Rural
Hunting	Daily Capacity/Acre	0.2
Water Based		
Swimming	Daily Capacity/Swim Unit	400
Fishing	Daily Capacity/Acre of Water	2
Boating	Daily Capacity/Acre of Water	0.75
Water Skiing	Daily Capacity/Acre of Water	0.5
Canoeing	Daily Capacity/Mile of Canoe Trail	48

1/ Source: Shaping the Future, The Indiana Outdoor Recreation Plan (1970).

Driving for pleasure does not have a projected need due to the lack of a use standard. However, it is an important activity and has related resources such as lakes, scenic vistas, historical spots, forests, parks, parkways, streams, and scenic roads.

Water based activities have three basic needs: (a) sufficient quantity; (b) public access to water; and (c) water of suitable quality.

Table V-13 shows the present resources and those required for projected land and water based recreational activities.

I. Fish and Wildlife

1. Relation of Changed Land Use And The Loss Of Wildlife Habitat

The late 1800's saw the beginning of agricultural development in the original "Grand Marsh" of the Basin which contained approximately 500,000 acres. Vast stretches of marshland and swamplands, broad floodplain areas broken by ridges and islands of various sizes, and numerous lakes existed in the area. These resources supported many forms of animal life including flocks of waterfowl, fur-bearing animals, fish, and an abundance of other wildlife. Agricultural development (largely prior to 1930) has reduced the "Grand Marsh" to slightly over 30,000 acres, resulting in a considerable loss and change of habitat and wildlife. Therefore, the remaining wetlands must be considered an outstanding and important natural resource of the Basin deserving of adequate protection. Protection through purchase or lease is needed for about 10,000 acres of these wetlands.

In 1972, a comparative habitat survey was originated to determine changes since about 1937. Jasper and Porter Counties were studied with the general trends considered to continue throughout the Basin. Factors observed and recorded during the survey included: total number of woodlots, total size of the woodlots, average size of the woodlots, whether shrubs were absent or present in the woodlots, the weighted percent canopy of the woodlots, miles of fence rows, miles of ditches, miles of natural streams, acres of urbanization, and the average field size.

Acreages of land in woodland types fluctuated according to the latent productivity of the soils. Woodland loss was most significant on high production soils. Poorer upland soils showed a significant increase in woodland acreage. When comparing whole counties, the woodland gain on poorer upland soils nearly offset the loss of woodland acreage in the high production soils.

One axiom of game management states that the amount of wildlife produced is proportional to the latent productivity of the soil. Although there was little overall woodland acreage change, the net woodland wildlife production has been significantly reduced because

TABLE V-13. PRESENT RESOURCES AND ADDITIONAL NEEDS FOR LAND AND WATER BASED ACTIVITIES
Kankakee River Basin (Economic Area), Indiana

Activity	Units	Existing Supply 1970	Additional Needs 1/					
			1970	1980	1990	2000	2010	2020
Land Based								
Picknicking	Acres	890	44	169	325	495	668	890
Tables	No.	6,940	5,420	7,060	8,960	11,084	13,428	16,112
Camping	Acres	500	2,123	2,449	2,824	3,230	3,682	4,182
Campsites	No.	2,700	16,407	19,341	22,716	26,370	30,438	34,938
Golfing	Acres	4,700	2,066	2,916	3,885	4,939	6,112	7,404
9-Hole Courses	No.	12	3	6	7	8	12	15
18-Hole Courses	No.	35	12	16	22	28	34	41
Snow Skiing	Acres	70	0	0	0	0	0	0
Slopes	No.	25	0	0	0	0	0	0
Bicycling	Miles	0	91	104	119	144	155	178
Hiking	Miles	60	440	501	574	657	746	853
Horseback Riding	Miles	50	342	378	465	542	626	726
Nature Walks	Miles	0	253	285	321	362	408	460
Hunting	Acres 3/	19	100	115	133	151	172	195
Playfields	Acres	1,798	1,512	1,957	2,482	3,072	3,712	4,467
Water Based								
Swimming	Acres	220	0	0	0	0	0	0
Boating 2/	Acres	27,900	32,900	40,700	49,600	59,300	70,100	82,100
Fishing	Acres	31,300	0	0	0	0	1,600	5,600
Water Skiing	Acres	5,875	28,725	33,125	38,225	43,825	49,925	56,825
Canoeing	Miles	0	257	289	326	366	411	461

1/ Need figures are cumulative.
2/ Does not include sailing.
3/ In Thousands

of the disproportionate loss of habitat on high production soils. The wildlife game species most affected would be those heavily dependent on woodland. These species would include the squirrel, raccoon, woodcock, and wood duck. Several kinds of nongame mammals and birds favoring woodland habitat include bats, shrews, chipmunks, flying squirrels, crested flycatchers, tufted titmice, horned owls, woodpeckers, flickers, sapsuckers and the screech owls. Others needing tall trees for resting include the red-tailed hawks, Baltimore orioles and the scarlet tangers.

The number of individual woodlots showed a significant increase in the more urbanized areas and slightly decreased in highly agriculture areas. An increase in numbers of woodlots would result in more "edge" habitat and a corresponding increase in rabbits, quail, and several species of songbirds.

The average woodlot size increased on the poorer agricultural soil where urbanization was most pronounced. The high production soils, where the potential for wildlife production per acre is highest, showed a decrease in woodlot size.

The survey showed an increasing percentage of woodland canopy. This has probably resulted from decreased burning and pasturing of woodlots. A reduction in the use of home grown wood products could account for some of the increase in canopy. With few exceptions, woodland wildlife would benefit from the increase in canopy. However, ground dwelling wildlife such as quail and rabbits would be adversely affected as the low growing cover is shaded out.

Miles of fence rows decreased significantly in the high production soil. The low production soils in areas where urbanization is increasing most rapidly showed a remarkable gain in miles of fence row. All wildlife population using fence rows for cover, travel lanes, and food would be expected to increase or decline accordingly.

In general, field size is increasing. Urbanization tends to decrease field size while intensive agriculture on high production soils creates larger fields. A close inverse relationship has been found between miles of fence row and average field size.

No significant change was noted in miles of ditches.

In all areas it was found that urbanization is increasing. The high production soils showed a minimal increase while poorer soils exhibited large increases. Most wildlife populations showed increased populations during early stages of urbanization. However, as small acreages are reduced to homes and lots, wildlife rapidly diminishes. The higher wildlife populations brought about by urbanization are not available to most hunters though they can benefit the local residents.

2. Endangered and Threatened Wildlife and Plants 1/

Within the Basin and nationally, the Indiana bat, Southern bald eagle, and the Artic peregrine falcon are considered endangered. The greater prairie chicken and sandhill crane are listed as threatened nationally. The State of Indiana has listed six additional species as endangered in the state; however, the natural range of three of these species is believed to be restricted to central and southern Indiana which is outside the Kankakee River Basin. The remaining three species are the bobcat, badger and otter. Indiana also lists over 60 other nongame species of animals in need of management. To date no state or national list of threatened or endangered plants has been published. The Basin supported Indiana's last stronghold of 500 native prairie chickens during the past quarter century. The prairie plants required by this species have been depleted to the point that the prairie chicken has become extinct in Indiana.

For all of these animals, the public needs to be made aware of their precarious status. Preservation of their existing habitats and development of additional habitat areas are the major needs.

3. The Effects of Flooding, Sediment Deposition, and Water Quality on Fish and Wildlife Resources

The effects of flooding in the Kankakee River Basin is regarded as an asset to fish and wildlife resources. The flooding and poor drainage of many areas account for both quantity and quality of the remaining habitat by restricting more intensive development. Forms of wildlife and vegetation occur in "flood-areas" that are not only capable of surviving high water but, in some cases, are highly dependent upon it.

The problems of sediment and water quality as occurring today also have little or no effect on plant and wildlife populations. These problems, however, have had an adverse effect on some species of fish, such as smallmouth bass and trout, because they are highly intolerant of these conditions.

The water quality conditions (disregarding sediment content and temperature) within the Basin are generally acceptable with respect to fish and wildlife requirements. On a number of ditches (Travis, Niespodziany, Curtis, Montgomery, Cedar Lake, and the lower portion of Potato Creek) fishery populations are degraded due to domestic, municipal, and industrial discharges.

The problems of high sediment content and temperature are significant but generally local in nature. These problems are associated with drain "clean-out" excavation and bank clearing.

1/ Reference: Federal Register Vol. 40; No. 188 dated 9-26-75 and Vol. 41; No. 83 dated 4-28-76 and Indiana Department of Natural Resources, Division of Fish and Wildlife Summary Report on Non-game and Endangered Species

4. Need for Additional Fish and Wildlife Habitat

The existing wildlife resources - wetlands, upland, and natural or near-natural streams - need to be preserved and maintained. This, however, is not adequate for either present or future needs. Additional habitats are necessary not only to increase the available habitat base but to diversify the predominant row-crop monoculture.

Improvements need to be made in fish and wildlife areas including; development and maintenance, overall water quality, agricultural land-use, and land treatment practices. In summary, the immediate need is for protection of about 10,000 acres of existing classified wetlands, protection and management on about 140,000 acres of woodland habitat, and protection or improvement of about 635 miles of fisheries and riparian wildlife habitat.

5. Access

The public's lack of adequate access is currently a problem in regard to the utilization of fish and wildlife resources, but in the future it will become a wide-spread need for both consumptive and non-consumptive uses. Limited problems of access will soon increase because of increasing urbanization and other developments. This will be compounded if decreases or degradations of existing fish and wildlife resources are permitted. Public-controlled areas need to be increased and access to private lands improved.

VI. PLANNING OBJECTIVES, METHODOLOGY AND ASSUMPTIONS

A. Relationship to Type 1 Study VI - 1

B. Objectives VI - 1

C. Procedures and Assumptions VI - 2

CHAPTER VI. PLANNING OBJECTIVES, METHODOLOGY, AND ASSUMPTIONS

A. Relationship to Type 1 Study

The Kankakee River Basin is a tributary of the Illinois River which outlets into the Mississippi River. As such, it comprises a portion of the Upper Mississippi River Basin and was, therefore, a part of the area included in the Upper Mississippi River Basin Comprehensive Framework (Type I) Study. The Kankakee River comprises a portion of the Illinois River Plan Area (No. 5) which is one of 17 Plan Areas into which the Upper Mississippi River Basin area was divided. The Upper Mississippi River Basin Comprehensive Framework Study, which provides a broad framework plan for water and related land resources, was completed in 1972.

The Kankakee River Basin in Indiana comprises an area of about 2,996 square miles as compared to 189,000 square miles in the entire Upper Mississippi River drainage. It is readily apparent that even though basic planning assumptions were similar, the Kankakee River Basin Study has been directed toward the solution of problems which are more regional and localized in nature than was possible in the Type I Study. Due to the much smaller scope of the study area, more detailed studies of problems, projected needs, and potential solutions were possible. This is one of the primary purposes for conducting Type 4 studies such as the Kankakee River Basin Study in areas on which Type I Framework Plans have been prepared.

B. Objectives

Plans for the use of the water and land resources are directed toward improvement in the quality of life through contributions to the objectives of national economic development and environmental quality. The beneficial and adverse effects on each of these objectives are evaluated and displayed in Section IX as to their impact on the nation and the region (state and local). The planning effort is directed toward the best use of water and related land resources as they relate to existing and projected problems and needs and toward identification of alternative methods or programs of action which can be used to improve the public decision-making process.

Existing or projected problems and needs expressed by the Basin residents and indicated through collection of basic data demonstrate the need for a consolidated effort in planning and implementing actions for the best resource management and use. Solutions to many of the identified problems and needs will require multigovernmental actions, and their resolution will require cooperation by many levels of government and private interests. The identification of some of these governmental entities and the programs or assistance available is part of the objective of this study.

Beneficial and adverse effects of alternative solutions are measured in both monetary and nonmonetary terms in Section IX. The priorities and preferences of the various groups and individuals affected by recommended action will vary, and accordingly, there will likely not be full agreement among all affected on whether certain effects are beneficial or adverse. However, the recommended plan represents an implicit expression of those actions considered to be the priorities and preferences of the public as well as could be determined through the process of public involvement and public response to the earlier drafts of this report.

C. Procedures and Assumptions

1. Study Approach

A look to the future, a specific statement of goals, and a plan of action are essential to any water resource program. For the Kankakee River Basin Study, the initial questions were: What and where are the needs? What are the possible solutions? How can the solutions be implemented?

To adequately respond to these questions and many more, a plan of study contemplated a complete investigation of needs and potentials for development of all purposes of water and related land resources in the formulation of a detailed framework plan. A determination of the needs and potentials to serve the comprehensive objectives requires participation by federal, state, and local agencies whose inherent interests and responsibilities are involved. These agencies cooperated with the Kankakee River Basin Coordinating Committee in the formulation and evaluation of plans of improvement to the extent their respective interests were affected.

The study was approached in two phases. The initial phase was directed toward the identification of resource problems and determination of present and future resource development needs. The second phase was concerned with the formulation of alternative plans of improvement to solve the identified problems and meet the present and future resource development needs compatible with the basin development concept.

2. Planning Assumptions

The comprehensive nature of this investigation required, for purposes of practicality, several basic assumptions. For example, it was assumed that for the period of this study, the federal, state, and local interests in water resource development will remain unchanged. Assumptions falling into a general category applicable to many of the study inputs are discussed

in the following sub-paragraphs. Assumptions which are limited to a particular subject are discussed in the appropriate chapters.

Economic Activity: The projections of economic activity in the Basin are based primarily on the OBERS 1/ projections of regional economic activity in the United States. The OBERS Series C (moderate growth rate) projections used in this study are based on a set of assumptions which represent those conditions believed to have the greatest probability of occurrence in the long run. The projections, therefore, represent estimates that would result if all assumed conditions materialize. These general assumptions are:

(1) Growth of population will be conditioned by a decline of fertility rates from those of the 1962-1965 period.

(2) Nationally, reasonably full employment, represented by a 4 percent unemployment rate, will prevail at the points for which projections are made: as in the past, unemployment will be disproportionately distributed regionally, but the extent of disproportionality will diminish.

(3) No foreign conflicts are assumed to occur at the projection dates.

(4) Continued technological progress and capital accumulation will support a growth in private output per manhour of 3 percent annually.

(5) The new products that will appear will be accommodated within the existing industrial classification system, and therefore, no new industrial classifications are necessary.

1/ U.S. Department of Commerce and U.S. Department of Agriculture, 1972 OBERS projections of economic activity in the United States, Volume 1 (Concepts, Methodology and Summary Data) prepared for U.S. Water Resources Council, Sept. 1972, 109 p. OBERS is an acrononym for Office of Business Economics (OBE - currently known as the Bureau of Economic Analysis, U.S. Department of Commerce) and the Economic Research Service (ERS) U.S. Dept. of Agriculture.

(6) Growth in output can be achieved without ecological disaster or serious deterioration, although diversion of resources for pollution control will cause changes in the industrial mix of output.

The Kankakee River Basin projections are based upon the following additional assumptions:

(1) Most factors that have influenced historical shifts in regional "export" industry location will continue into the future with varying degrees of intensity.

(2) Trends toward economic area self-sufficiency in local-service industries will continue.

(3) Workers will migrate to areas of economic opportunities and away from slow-growth or declining areas.

(4) Regional earnings per worker and income per capita will continue to converge toward the national average.

(5) Regional employment/population ratios will tend to move toward the national ratio.

Regional assumptions (4) and (5) are corollaries of assumption (3). They are in the nature of central tendencies only. In some circumstances they may be counterbalanced by other forces. The migration of retired people to attractive retirement areas without regard to economic opportunity is an example of this counter-effect.

The population was projected by attributing to the Basin a future share, based upon established trends, of national population growth as estimated by the U.S. Dept. of Commerce, Bureau of Economic Analysis, Series "C", moderate growth rate. These Series C projections were used in conjunction with the Indiana State Water Plan population projections.

Related Lands: The related lands under consideration in this study are defined in the Water Resources Council Guidelines. Related land is that on which projected use and/or management practices may significantly affect the runoff pattern or quality of the water resource to which it relates and land that is significantly affected by existing or proposed measures for the management, development, or use of the water resource to which it relates.

Technological Advances: Future advances in technology were taken into account for projections of municipal and industrial water supply and agricultural production.

Project Potentials: It was assumed that elements of all on-going programs would be utilized to meet some of the growing needs of the Basin.

Price Levels: Price levels prevailing in 1973 were used for evaluating the present and future benefits and costs. The beneficial effects from agricultural production were evaluated on the basis of current normalized prices. 1/

Interest Rate: An interest rate of 6 1/8 percent was used in the monetary evaluation of beneficial effects and in amortizing estimated capital costs for installation of recommended actions.

Benefits: The aim of water resources projects and programs is to satisfy the human environment - the human needs. Capital goods and services are produced to achieve this goal. These goods and services have value in accordance with demand for them and their relative scarcity. Thus the net monetary benefits in this report represent the estimated increase in value of goods and services of a project expected for a period under study from which losses, if any, have been deducted.

1/ Current Normalized Prices from "Water Resources Council Guideline 2: Agricultural Price Standards for Water and Related Land Resource Planning - February 1974", U.S. Water Resources Council, Washington, D. C.

VII. EVALUATION OF RESOURCE CAPABILITY AND OPPORTUNITIES

A.	Resource Land Use, Treatment, and Development	VII - 1
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CHAPTER VII. EVALUATION OF RESOURCE CAPABILITY AND OPPORTUNITIES

This section of the report relates primarily to the physical capabilities of the Basin to supply the needed water and related land resource development. It is not aligned toward specific programs or projects. The process of framing alternative plans to meet the current and projected needs for resource development necessarily requires an evaluation of the full physical capabilities of the Basin. Such an evaluation establishes the maximum development capacity within which plans may be formulated for practical and efficient solutions to current and future identified needs.

More specifically, this section deals with the availability of land as related to present and projected requirements for alternate levels of development. Land treatment is presented in terms of total needs as determined in the Conservation Needs Inventory. Although these are considered to be immediate needs, it must be recognized that their application is dependent to a great extent on the preference and financial resources of individual landowners. Other types of developments including agricultural drainage, flood prevention, and water supply are presented in terms of their physical capacity to solve the problems and to meet the identified need.

A. Resource Land Use, Treatment, and Development

The Basin land base is sufficient to permit a rather wide range in land use adjustments. The agricultural land base is adequate to absorb the projected increase in urban and built-up land requirements along with land for associated recreational and transportation facilities. Reductions in the agricultural land base (inventory land) from urban expansion are projected to be approximately 57,160 acres by 1990 and more than 96,310 acres by 2020, as shown in Table IV-6. Advances in agricultural technology which result in increased yields on the land remaining in agricultural production will more than offset these losses.

The opportunities for installation of land treatment measures on agricultural lands are many. More than 71 percent of the Basin cropland, or 955,510 acres, is in need of some type of treatment, as indicated by the Conservation Needs Inventory (1968). This includes 35,900 acres currently in cropland which need a change in land use to permanent cover of grass or trees. These acreages represent the total potential for treatment of agricultural lands. Although adequate treatment of all agricultural lands would be desirable, it is not realistic to plan for 100 percent accomplishment of this goal. In addition, lands projected to change to non-agricultural uses; such as urban, built-up, and other uses; must be deducted from the agricultural land base.

Opportunities for adequate treatment and management of the Basin's forest resources exist on 85,510 acres of the 142,160 acres of forest land. Currently only 56,650 acres or 40 percent of the forest land is adequately treated.

Land base recreational activities in which forest land plays a major role are hunting, nature walks, hiking, horseback riding, camping, and picnicking. Although perhaps not absolutely necessary, forests do enhance many other recreational pursuits as well - shade for fishing pleasure; to act as rest areas; and to provide screening effects for golf, swimming, tennis, pleasure driving, and many other activities.

Trees add to the enjoyment of recreation and they are often planted to enhance this enjoyment if they are not already present on the recreational areas. Of course, these planted trees take time to grow, and this prolongs the time until full enjoyment of the area is reached. Protection and improvement of existing stands of trees in areas which have a potential for recreation is essential to avoid this time lag.

Demand, supply, and needs projections (Tables V-11 and V-13) indicate there is presently a larger demand than supply in all the recreation activities commonly associated with forest land. Table V-13, however, indicates only part of the actual supply and need situation for the forest oriented recreation activities. The supply figures represent only those acres that are specifically set aside to satisfy the individual recreation uses. The demand figures are based on participation by the total area population on all open-space lands, whether developed or not. Because of the dispersed nature of activities such as hunting, nature walks, hiking, and horseback riding; they are not generally confined to areas which must be restricted to these uses. Nearly every acre of forest land, regardless of size or condition, has the potential for some type of recreation use or contributes to the enhancement of some recreation use. The two major factors which restrict use of forest land for recreation are access to the area and the quality of the recreation experience being sought. Access to the area, as used in this discussion, means permission by landowners to allow public use and not the transportation system necessary to get to the recreational site.

The potential for utilizing forest land to expand the supply of recreation areas needed, not only for the future but also for the present, are limited only by the acres of forest land available for development and the incentive for the landowner to utilize his land to produce recreational benefits as well as other management objectives. Examples of this dual use include: timber production and hunting or camping; tree planting for water and wind erosion protection, thus, providing additional game habitat and cover; and many others.

Landowners are not expected to provide these improved recreational opportunities to the public free of charge. Only an expression from the public of their willingness to compensate the landowners for the cost involved in producing the recreation opportunity will generate the interest necessary to provide the opportunities. These costs are many and varied. They cover everything from loss of the land to other investment or management goals to the actual cost of installing and maintaining any facilities that might be required. Recovery of these costs to the landowners as well as a reasonable profit above costs will generate the necessary interest in the landowners to provide for the recreational needs of the public. Very often when wildlife and recreation are mentioned, it is in the context of a consumptive use.

Wild game is hunted with the goal being a delicious meal. Hunting satisfies a real need for many people while others prefer non-consumptive uses such as the pleasure of just watching the animals, photography, and other reasons. An example of how the opportunity to satisfy these needs is being met is occurring on a portion of the Kankakee River Basin in Jasper and Porter Counties. A report entitled " A Comparative Habitat Survey for the Years 1937-1971 in Jasper and Porter Counties, Indiana"1/ by the Indiana Department of Natural Resources - Division of Fish and Wildlife, reveals what is happening to wildlife habitat in these two counties.

This report indicates that the 10 to 40 acre tracts for a home site and undeveloped urban fringe land owned by speculators can generate a positive result for wildlife. There are more acres of forest land habitat available now than in 1937 in northern Porter County (an 81 percent increase in forest land between 1937 and 1965) while there was a 332 percent increase in urbanization during the same time period. Species of animals and birds will change with urban development. The English "house" sparrow, European starling, and common pigeons account for 50 to 70 percent of the bird life found in developed urban residential areas.

B. Flood Prevention, Erosion and Sediment

1. Agricultural

There are 32 identified reservoir sites in the Basin of which seven (7) offer potential for use in reducing flood damages, but only in conjunction with other beneficial water uses. Most of the sites have physical limitations in available storage or water-holding potential and in their proximity to high flood damage areas. There were no identified needs for development of these sites in the Basin; therefore, none of the sites is recommended for early development. As needs arise, the sites could be considered as water storage areas for various beneficial uses.

1/ Unpublished Reference

Major channel work was considered for flood control since potential control by dams is limited. The present flood damages along 13 major tributaries and the main channel will support extensive channel work. Other tributaries and local areas with a high concentration of cropland offer some potential for additional channel work in conjunction with drainage needs.

The adoption or amendment of flood plain zoning ordinances is recommended for the entire Basin. Major structural work cannot entirely eliminate flooding; therefore, this nonstructural method for flood protection is perhaps the single most important and versatile tool for reducing future flood damages. In Indiana, effective flood plain zoning is a cooperative effort of the state and local government.

There is potential for reducing soil erosion on the Basin. This reduction can be accomplished by improved land use and by the application of needed land treatment measures, including erosion control practices. The conversion of about 35,900 acres of cropland with a severe erosion hazard to a permanent cover of grass or trees will reduce the estimated average annual gross erosion on these acres from nearly 3 tons per acre to less than one-half ton per acre. In addition, the application of recommended land treatment management practices can reduce the gross erosion on the remaining cropland; such practices includes improved crop rotations, crop residue use, and the use of minimum tillage methods.

In addition to protecting the soil resource base, the potential reduction in soil erosion will reduce problems related to sedimentation. Probably the most important impact would be a decrease in the rate of sediment deposition in the drainage channels. Such a reduction would result in a decrease in the operation and maintenance costs of the open ditch drainage systems. Another significant impact would be a reduction in turbidity of stream and lake waters. In addition, the potential for pollution of the surface waters by agricultural nutrients and pesticides would be reduced.

2. Urban

Flood protection was considered for several communities adjacent to the Kankakee River. The opportunities for agricultural flood protection as previously discussed are based upon a 1-year level of protection which is inadequate for these communities. Several methods were considered for achieving flood damage reduction in the communities of Schneider, Shelby, Sumava Resorts, Wildwood and Shady Acres. These methods included channel deepening and enlargement, construction of levees around the communities and upstream floodwater retarding reservoirs.

Detailed studies will be required to determine if local protection projects can be developed that are engineeringly and economically feasible for any or all of these communities. Some of the housing may be too close to the river to permit construction of adequate protection without having an adverse effect on flood stages. Studies for the communities of Schneider and Shelby should consider levees along with pump installations to remove interior drainage waters. Studies for Sumava Resorts, Wildwood and Shady Acres should consider a combination of levees, floodwalls, interior drainage ditches and pumps, and relocation of some dwellings. Some type of flood gate or lock would be required in the meander cutoff channel leading into Shady Acres.

It should be recognized that unique engineering features would be required at these locations. Consequently, the costs are expected to be large and economic feasibility is questionable.

C. Water Supply Development

Water supply developments for municipal and industrial as well as agricultural and other rural uses will primarily involve utilization of the ground-water resource. The potential for ground-water development is considered good to excellent in much of the Kankakee River Basin (Plate 8). Wells with capacities of 250 gallons per minute and greater can be obtained in approximately two-thirds of the Basin. Limited supplies of water are available in other areas. The Iroquois area, for example, may be characterized as having a poor to good potential for ground-water development, depending upon the location.

Ground-water is the principal source for rural domestic use. With the possible exception of relatively small scattered areas, ground-water sources are expected to be adequate to meet the projected rural domestic needs.

Similarly, ground-water will continue to be a significant source of water for livestock. Ground-water supplies are believed to be adequate to meet some of the increased needs for irrigation water, provided that the increased irrigation acreage is planned for areas with good ground-water supplies as well as adequate soils.

While the quality of ground-water may not always be completely desirable or meet the standards, it should be possible to treat the deficiencies and continue to use the resource.

D. Recreation and Open Space

The Kankakee Basin has numerous natural resources that provide opportunity for recreational development. Distribution of these resources throughout the Basin makes it possible to provide recreational opportunities where the people live. Well planned development of available resources will satisfy many of the recreation demands.

1. Land Based

Currently there are 58,926 acres of designated recreational land within the Economic Area. This is about 39 percent of the present needs, (134,000 acres) and only 22 percent of the projected needs for the year 2020 (241,300 acres). The largest area requirement is for hunting, which comprises about 89 percent of the present and future needs (119,000 and 214,000 acres respectively).

Riverside recreational developments or corridors along some of the streams of the Basin can be utilized as a major resource to satisfy many of the land based recreational activities such as bicycling, hiking, picnicking, and others. Some change in land use may be required in some areas where recreational development will occur. Cropland can be used to satisfy a portion of the hunting demands, providing access is made available.

2. Water Based

The Economic Area contains several water areas which offer opportunities for recreational development. Inventoried Type 5 wetlands total about 18,610 acres, and presently there are about 3,681 acres of designated recreational water areas in the Economic Area. Seventy-three percent of the Type 5 wetlands are less than five acres in size, while in the Basin there are about 50 lakes with 10 acres or more containing a total of about 10,000 acres.

The various designated and undesignated water areas satisfy the present recreational demands for swimming and fishing, but do not satisfy the demand for boating, water skiing, or canoeing. The Kankakee River provides canoeing opportunities to satisfy existing and some of the future demands. Although the Basin has an ample supply of water areas, due to the small size of many of these areas they are not capable of supplying all the specific recreation demands. Sufficient water areas are available to meet fishing demands; however, water quality needs to be improved in some areas to provide for a more desirable species of fish.

E. Fish and Wildlife

Cropland, forest land, and pastureland provide food and cover for wildlife; although, some are available only on a seasonal basis. A variety of habitat is provided along the streams and the approximate 32,340 acres of classified wetlands in the Economic Area. These wetlands vary in size and type and, therefore, offer habitat to a wide variety of wildlife species.

Water resources of the Basin are sufficient to supply fishery needs, and water quality is satisfactory for the production of warm water fish. Water quality needs to be improved in areas where pollution occurs to enable the production of a larger variety of desirable fish species.

Opportunities exist for improving fish and wildlife habitat by further development and maintenance, improved land use, and the application of approved land treatment practices on both public and private land.

F. Drainage

There is potential for channel work for drainage in many Basin areas - main channel, tributary, and on-farm. These areas have an identified need for drainage to aid agricultural crop production on existing cropland. Over 180,000 cropland acres are identified which will require major channel work and/or levees and pumps for a solution to the problem. In addition, over 439,350 cropland acres have an identified drainage problem which will require either local group or drainage board action, or individual on-farm action due to their size and number of beneficiaries.

The potential for large-scale drainage measures (channel work) was evaluated for the Kankakee River main channel and all major tributaries to the Kankakee River. Feasible solutions have been identified for the Kankakee River main channel area and for 13 tributaries to the Kankakee River. Many tributary evaluations did not show net beneficial effects. There remains, however, potential for alternative corrective actions for the drainage problems in those and other areas. Pump drainage, selective channel excavation, debris removal, and/or tile and open ditch installation appear to be practical alternative solutions to many of the identified drainage problems on existing cropland. Further investigations and evaluations of these areas will be required to determine their potential for positive corrective measures.

G. Irrigation

There is more than an adequate supply of land in the Basin with soil conditions that are suitable for irrigation. The Ground

Water Availability Map (Plate 8) indicates that in general, well yields in much of the Basin can exceed 250 gallons per minute. Yields to wells can exceed 500 gallons per minute in the extreme northeastern portion of the Basin. It should be re-emphasized that the planning of irrigation projects should include adequate evaluation of the physical resources at each specific site. Such evaluation must include the suitability of soils and an analysis of the water withdrawal rates versus recharge rate of the aquifer(s) involved.

Rainfall patterns and amount are adequate for most years; therefore, large scale irrigation projects are not expected to develop. Ground water supplies should be adequate for expected future irrigation needs, provided the irrigation projects are planned on the basis of specific investigations of the soil and water resources.

H. Water Quality

The primary potential for improving water quality in most streams and lakes is through control of pollutants at their source. Adequate treatment of waste water from municipal, industrial, and commercial facilities must be accomplished in order to achieve the full potential for improving the Basin waters. Likewise, effective erosion control measures applied to the land would reduce the sediment load in streams. The proper use of fertilizers and pesticides would further reduce the possibility of contamination of the Basin waters.

The potential for maintaining and improving the quality of the Basin water resources lies largely in the availability of adequate stream pollution control laws and regulations and their enforcement. In that regard, the Indiana Stream Pollution Control Board, under the present Indiana Stream Pollution Control Law, Chapter 214, Acts of 1943, as amended, and the Environmental Management Act (PL-100), has the authority to control and prevent pollution in the waters of the state.

Stream Pollution Control (SPC) IR-3 established standards of water quality for the waters of the entire state. All waters, based on the use concept, will be required to meet the standards for the appropriate public and industrial water supply, aquatic life, recreational, and agricultural uses. Compliance with these standards will enhance the quality of water within this Basin. The minimum weekly flow, which occurs once in 10 years, will be used in applying these standards. It is recognized that the all-time minimum of flow will be less, but will occur only a very small percentage of the time. During these periods, only minimum damage to streams will result. The Board plans to require compliance with coliform standards for recreation during the recreational season of April through October, inclusive, and year around for water supply. There are, however, some uncontrollable sources of coliform pollution other than sewage treatment plants effluents, such as storm water runoff.

Table VII-1 describes the implementation plan for municipal wastewater treatment facilities. The accomplishment of this schedule would be a significant achievement toward developing the potential for improving the quality of the Basin waters.

In order to maintain the acceptable lake water quality conditions, several general recommendations have been suggested for implementation in all basins within the state. The implementation of these recommendations would require additional state laws and/or regulations and local ordinances. These recommendations represent a potential for meeting lake water quality needs and are summarized below:

a. The construction of new municipal or industrial waste treatment facilities which would discharge directly to any lake within the Basin should not be permitted.

b. All existing direct discharges into the lakes within the Basin should be eliminated. If this activity is not possible or practicable, then advanced waste treatment including nutrient removal should be provided.

c. All waste treatment facilities of significant size utilizing discharges to any tributary of a lake within the Basin should provide nutrient removal facilities.

d. A program should be initiated to ultimately provide sewer systems to serve all lakes which have significant shoreside development. In the interim, a program to check and correct malfunctions in the individual septic tank disposal systems around lakes should be undertaken.

e. Further channeling, extension of shorelines or dredging should be restricted unless it can be demonstrated that the ecological impact of proposed projects will be negligible.

f. Restrict future development of remaining vacant land surrounding the lakes to single family dwellings or cottages except in the case where a developer is willing to provide a sewer system and the type of treatment previously discussed.

g. Initiate a program to encourage the use of agricultural practices that would minimize sediment transport to the lakes or their tributaries. In the event the program fails, the implementation of some kind of land use zoning should be investigated.

I. Archeological, Historical, Scenic, or Unique Areas

Although archeological data are incomplete and the full archeological importance unknown, 793 sites have been recorded for the Kankakee

River Basin Economic Area. This rather large number of recorded sites is especially significant because most of the nine county area is not considered adequately surveyed.

Recording of historical and scenic areas in the Basin has been limited. Of the areas that have been recorded, many deal with local history or interests and would add little to the overall history of the Basin or be of interest to people on a Basin-wide level.

The natural areas of the Basin diminished as the competition for land grew. It is imperative that the limited number of areas that remain be considered for preservation. The twelve identified natural areas in the Basin, shown in Table III-20, have been assigned a priority rating for preservation by the Division of Nature Preserves, Indiana Department of Natural Resources.

TABLE VII - 1. MUNCIPAL IMPLEMENTATION PLAN FOR WATER QUALITY STANDARDS
Kankakee River Basin, Indiana

Municipality	Submission of Final Plans	Start of Construction	Completion	Treatment Required
Bremen		06-30-76	06-30-77	Expansion or infiltration control
Brook	06-30-73	12-31-73	12-31-74	Sewage treatment facilities
Demotte	12-31-75	12-31-76	12-31-77	Sewage treatment facilities
Earl Park	06-30-73	12-31-73	12-31-74	Sewage treatment facilities
Goodland	12-31-75	12-31-76	12-31-77	Sewage treatment facilities
Hamlet	12-31-75	12-31-76	12-31-77	Sewage treatment facilities
Hebron	12-31-75	12-31-76	12-31-77	Advanced waste treatment
Kentland	12-31-75	12-31-76	12-31-77	Advanced waste treatment
Kingsford Heights	12-31-75	12-31-76	12-31-77	Advanced waste treatment
Knox	---	06-30-73	08-30-74	Secondary and chlorination
Kouts	12-31-75	12-31-76	12-31-77	Advanced waste treatment
LaCrosse	---	12-31-76	12-31-77	Sewage treatment facilities
Lakeville	---	06-30-76	01-01-77	Chlorination
Lapaz	12-31-76	06-30-77	06-30-78	Sewage treatment facilities
LaPorte	12-31-75	12-31-76	12-31-77	Advanced waste treatment
Morocco	06-30-73	12-31-73	12-31-74	Sewage treatment facilities
North Liberty	---	07-18-73	07-17-74	Sewers and sewage treatment
Remington	12-31-75	12-31-76	12-31-77	Advanced waste treatment
Rensselaer	12-31-74	12-31-75	12-31-76	Additional sanitary sewers and expansion
Schneider	12-31-76	06-30-77	06-30-78	Sewage treatment facilities
St. John	---	12-31-76	12-31-77	Sewage treatment facilities or connection to Schererville
Wheatfield	12-31-76	06-30-77	06-30-78	Sewage treatment facilities
Walkerton	12-31-75	06-30-76	06-30-77	Sewage treatment facilities
Wanatah	12-31-76	06-30-77	06-30-78	Sewage treatment facilities

VIII. EXISTING PROJECTS AND PROGRAMS

A. USDA Programs	VIII - 1
B. Other Federal Programs	VIII - 3
C. State Agencies	VIII - 4
D. Local and Other Agencies	VIII - 14

TABLE VIII - 1: AGENCY ACTIVITIES IN WATER RESOURCE PLANNING AND DEVELOPMENT
Kankakee River Basin, Indiana

Activity: A - Basic Data; B - Studies and Research; C - Finance, Operation, or Construction; D - Regulation

	Agency	Activity
FEDERAL	Corps of Engineers	A, B, C, D
	Department of Agriculture	A, B, C, D
	Agricultural Stabilization and Conservation Service	A, C
	Farmers Home Administration	C
	Federal Extension Service	A, B
	Forest Service	A, B, C
	Economic Research Service	A, B
	Soil Conservation Service	A, B, C
	Rural Electrification Administration	C, D
	Department of Housing and Urban Development	C
	Department of the Interior	A, B, C
	Bureau of Outdoor Recreation	A, B, C
	U.S. Fish and Wildlife Service	A, B
	U.S. Geological Survey	A, B
	Environmental Protection Agency	A, B, D
STATE	State Planning Services Agency	A, B, C
	Department of Natural Resources	A, B, C, D
	Environmental Management Board	D
	State Board of Health	A, B, D
	Stream Pollution Control Board	A, B, C, D
	Indiana University	A, B
	Purdue University	A, B
LOCAL	Conservancy Districts	A, B, C
	Soil and Water Conservation Districts	A, B
	Water, Sewage and Solid Waste Districts	A, B, C
	Planning and Zoning Agencies	A, B, D
	Counties, Cities and Towns	A, B, C, D

VIII. EXISTING PROJECTS AND PROGRAMS

Many state and federal agencies supply services to meet resource conservation needs in the Basin. Although the programs of these agencies are comprehensive, the present level of operation in manpower and funding is below present development requirements.

A. USDA Programs

The PL-46 Program includes activities authorized in 1935 under the Soil Conservation Act (Public Law 74-46). The Soil Conservation Service under PL-46 carries on a broad program of soil and water conservation operations including direct technical assistance to landowners and operators and technical services to other agencies and organizations.

The primary job of the Soil Conservation Service is to provide technical assistance to Soil and Water Conservation Districts in helping landowners and operators, individually or in groups, do conservation work on the land. Such work is basic to, and is a necessary foundation for, watershed protection and other soil and water conservation activities in both rural and urban areas. Related activities include soil surveys and soil investigations, helping find and improve plant materials for conservation uses, and providing technical services in connection with other USDA programs involving financial or other assistance in conservation work.

Assistance to Soil and Water Conservation Districts and other qualified sponsors is also available for developing group action programs through the Watershed Protection and Flood Prevention Act (Public Law 83-566, as amended). Applications and project plans must be approved by the state and federal government. In the Kankakee River Basin, 13 such applications have been submitted, of which one has been approved for implementation (now inactive), four are currently inactive, one is in the planning stage, and action on seven applications is pending.

In 1962, Congress passed the Food and Agriculture Act (Public Law 87-703) which authorized the organization of Resource Conservation and Development (RC&D) areas. This program authorizes technical, financial, and loan assistance to legal sponsors in approved areas where community benefits are achieved in solving identified natural resource related problems. Resource conservation and development areas provide local leadership with the opportunity to coordinate and use local, state, and federal facilities more fully in developing and carrying out a plan of action for the orderly conservation and development of natural resources and the economic improvement of the area. The Arrow Head Country RC&D Area was authorized for operations in May 1976 and includes that part of the Kankakee River Basin located in Jasper, Newton, and Starke Counties.

The Agricultural Stabilization and Conservation Service program has provided-sharing to farmers in implementing soil, water, woodland, and wildlife conservation practices on farmlands now in agricultural production. The program also provides aerial photos for conservation work and planning assistance for land treatment, residential and industrial development, and emergency measures for natural disasters.

Credit assistance is available from the Farmers Home Administration. This includes: (1) farm ownership loans, (2) farm-operating loans, (3) farm emergency loans, (4) loans for housing (both rural and urban), (5) loans for grazing associations, (6) loans to develop rural recreation enterprises and (7) watershed loans. Loans for water and waste disposal systems are available for rural districts or towns and villages. Construction loans for water facilities have been provided to Dyer (Jasper County) and North Liberty (St. Joseph County). Construction loans for sewer facilities have been provided to Boswell (Benton County), Lakeville (St. Joseph County), and Knox (Starke County).

The Extension Service is part of the cooperative extension service partnership. Three levels of government - federal, state, and county share in financing, planning, and carrying out extension educational programs. Extension Service acts as the education agency of the U. S. Department of Agriculture and the land grant universities. Extension specialists work with other agencies to provide local people information relating to soil and water conservation programs, and to provide technical assistance in analyzing recreational needs and developments. This work has been an integral part of USDA since 1914 when the Smith-Lever Act became law.

Cooperative federal-state forestry programs active within the Basin include Forestation, Forest Management, Insect and Disease Control, and Fire Control. The various services of these programs are provided by the U. S. Forest Service in cooperation with the Indiana Department of Natural Resources, Division of Forestry. Technical assistance is available for approved forest practices installed on private land. The U. S. Forest Service is cooperating with the state and other related agencies in multiple-purpose planning of public use areas.

Forestry programs in which the state and the U. S. Forest Service cooperate are largely directed to helping these small, private landowners plant, grow, and protect or market their timber. Many cooperative programs are well established and that represents progress in this area. These programs also provide technical assistance for urban and environmental forestry.

The Economic Research Service provides economic analyses of the effects of alternative resource uses on various aspects of the nation's agricultural life including food supplies and costs, farm income, and the costs of government programs. The principal effort concerning the economic analysis of water and related land resource use is carried

on by the Natural Resource Economic Division of the Economic Research Service. Economic analysis and projections are carried on in river basin planning with research also conducted concerning water rights, water quality, watershed program analysis, outdoor recreation, land tenure and income distribution, rural zoning and other land use controls.

The Rural Electrification Administration was created by Executive Order 7037 on May 11, 1935, and currently operates under authority of the Rural Electrification Act of May 20, 1936, as amended. It administers loan programs for rural electrification and rural telephone service. Loans are made to finance electric distribution, transmission, and generation facilities to bring initial and continued adequate electric service on an area coverage basis to persons in rural areas who do not have central station service. Loans are also made to finance facilities to furnish and improve telephone service in rural areas on an area coverage basis.

The Rural Electrification Act, as amended, establishes the interest rate on all REA loans at 2 percent and fixes the permissible loan repayment period at a maximum of 35 years. An application is approved by REA only after legal, engineering, economic, and financial studies. Funds are obligated by a loan contract and the borrower gives a note, mortgage, and in some cases other security. Funds are advanced as needed for carrying out the construction.

REA furnishes its borrowers with technical assistance in engineering, accounting, and operations in support of the security of the government loans. REA also assists its borrowers in initiating projects to stimulate economic development in the areas they serve.

B. Other Federal Programs

The U.S. Army Corps of Engineers, Chicago District, has authority to plan and construct major reservoirs and local protection measures for flood control and to improve navigation. Flood control studies have been made on the Kankakee River and the Iroquois River. Reviews of proposed flood control channel work have indicated that major improvements were not environmentally acceptable. The Corps of Engineers maintains an on-going program to review periodically the needs for planning and implementation of major flood control and navigation measures.

The Corps of Engineers' authority for rivers and harbors dates back to 1824. Their scope of and requirements for water resources projects have developed through a long series of river, harbor, and flood control acts. Responsibilities have been added by statute in the fields of flood control, hydro-electric power, municipal and industrial water supply, recreation, and planning for all functions of water resources development.

The U. S. Department of the Interior provides assistance to state, local, and federal agencies through technical assistance by the U. S. Fish and Wildlife Service and financial assistance by the Bureau of Outdoor Recreation.

The Upper Mississippi River Commission was formed during 1972 under the authority of the Water Resources Planning Act of 1965 (Public Law 89-80). The Commission is empowered to conduct and coordinate water and related land resources planning within those portions of North Dakota, Wisconsin, Minnesota, Iowa, Illinois, and Missouri which are drained by the Upper Mississippi River system. Although Indiana is not represented on the Commission, the activities within the Kankakee River Basin are important to that portion of the Basin within Illinois and the receiving streams in that state.

The Commission's specific responsibilities are to serve as the principal agency for coordination of all plans for development of water and related land resources in the Basin and to prepare a comprehensive plan and recommend long-range schedules of priorities for the collection and analysis of basic data and for investigation, planning, and construction of projects.

C. State Agencies

There are several departments and agencies of state government which have vested interests in or are concerned with some phase of water management. Those having a major input into this Basin Study are:

1. Department of Natural Resources

The Department of Natural Resources is assigned the responsibility of managing the natural resources of Indiana. Using the findings of research by professional personnel in many fields, the Department endeavors to carry out conservation programs which will make the wisest use of the resources. At the same time it tries to meet the tremendous demands of public use.

Indiana's Department of Natural Resources was formed on July 1, 1965. Formation of the Department was primarily a reorganization, combined with a merger of the former Indiana Flood Control and Water Resource Commission, the State Soil and Water Conservation Committee, the Recreation Council of the State Board of Health 1/, and the Department of Conservation.

Under the Director of Natural Resources, two bureaus, each headed by a deputy director, were formed. The Bureau of Land, Forest and Wildlife Resources contains all the land-holding divisions such as Forestry, Fish and Wildlife, Parks, Museums and Memorials, Reservoir Management, Nature Preserves, and the Division of Outdoor Recreation, Engineering and Planning, Reclamation, and Entomology.

1/ The Recreation Council of the State Board of Health was abolished by Acts of 1969, Chapter 297.

Under the Bureau of Water and Mineral Resources are the Division of Water, the Geological Survey, Soils, and Oil and Gas Division, and the State Soil and Water Conservation Committee and State Water Plan Section.

The Division of Forestry has primary responsibility for the protection, management, and utilization of the forest resources of the state and for statewide fire protection on both state and private forest lands. The division provides technical advice and assistance to private woodland owners and primary wood using industries. The Reforestation Section is responsible for the production and distribution of tree seed and seedlings for reforestation and reclamation work on both state and private lands.

The Division program includes the operation and management of about 140,000 acres of forest lands in thirteen state forests, the operation of two forest nurseries, and the sale and distribution of planting stock. Also, the Division provides technical assistance to woodland owners and primary wood using industries through fourteen service forestry districts; maintains fire patrol flights to cover five fire districts as a fire detection system; and administers the provisions of the Act regulating surface mining. The Division also provides technical assistance in woodland management on Public Law 566 (Small Watershed Projects).

Programs designed to assist forest land owners and operators in proper management and protection of their forest land are presently available in the Basin area. The cooperative Forest Management Program is a cooperative effort between the Indiana Department of Natural Resources, other technical assistance to landowners in proper management techniques, availability of markets, timber marking, and other aspects of good forest management.

Protection from fire is provided through a cooperative effort between the Division of Forestry and the U. S. Forest Service (Cooperative Forest Fire Control Program) and agreements between the Division of Forestry and local fire departments in the Basin area.

Approximately 501 forest land owners have placed a total of 13,066 acres in management under the classified forestry program. The main objective of this program is to encourage better private forest land management and protection. The incentives for landowners to classify their lands and practice better management are the reduction of the assessed value of classified lands to $1.00 per acre and continual technical advice and assistance.

The Division of Fish and Wildlife is responsible for the protection, management, control, and enhancement of all non-domestic populations of fish and wildlife within this state. This includes non-game species as well as sport or game species. It is also responsible for providing for hunting, fishing and related outdoor recreation

activities on public and private lands; providing for fish and wildlife habitat improvement and protection; establishing fish and wildlife habitat improvement and protection; establishing fish and wildlife regulations; and carrying out scientifically sound fish and wildlife propagation, management and research programs.

To minimize the problems in the management of fish and wildlife resources, a research program is carried on to provide better guidance. Fisheries research has included inventory surveys of a number of lakes and streams.

The Division operates eight fish hatcheries to provide fish to stock new lakes, reservoirs, and state-owned lakes. Game research is aimed at improving game management practices. A game management program is carried out to provide more and better habitat for wildlife. The Farm Game Habitat Restoration Program furnishes seed, seedlings and grain to aid rural landowners in wildlife development plans.

The U. S. Fish and Wildlife Service, U. S. Department of the Interior, provides technical assistance to the Division, and other state and federal agencies, in analyzing fish and wildlife needs and recommending programs for protection and enhancement of fish and wildlife habitat.

The Division acquires and operates lands and waters for fish or game management, outdoor activities, public fishing and hunting, and flora and fauna preservation. Properties now owned by the state and managed by the Division within the Basin are: Kankakee State Fish and Wildlife area, Jasper-Pulaski State Fish and Wildlife area, Kingsbury State Fish and Wildlife area, Beaver Lake Nature Preserve, Bass Lake State Fish Hatchery, Swamp Rose Nature Preserve, and Rix Woods.

The <u>Division of Outdoor Recreation</u> is dedicated to enhancing the outdoor recreation opportunities in Indiana through the provision of financial and technical assistance and recreation resource planning. This is accomplished by administering the following programs.

a. Land and Water Conservation Fund Program. This program provides over four million dollars annually for the acquisition and/or development of recreation facilities on both the local and state levels.

b. Outdoor Recreation Planning Program. The Division is constantly involved in the recreation planning process updating outmoded plans, working to implement existing plans, and as-

sisting local agencies in recreation planning. Special studies such as Off Road Vehicle Study, Abandoned Railroad Rights-of-Way Study, and Scenic Streams Study, among others are being accomplished periodically.

c. A-95 Review Program. The Division serves as a clearinghouse for all comments on federal aid applications by other divisions. These comments are consolidated into one department statement for each application.

d. Environmental Impact Statement Review. The Division also serves as a clearinghouse for all comments on Highway Environmental Impact Statements. Differences between divisions are arbitrated and a consolidated department statement is prepared.

e. Trails and Rivers Implementation Program. The Division has been assigned the responsibility of implementing and coordinating the development of an Indiana trails system and the Natural, Scenic, and Recreational River System in Indiana.

The Division of Entomology as the principal plant regulatory agency of Indiana is charged with the responsibility of preventing the introduction and spread of insect pests and plant diseases. Japanese beetle, gypsy moth and others are cooperative plant protection and quarantine programs with the U. S. Department of Agriculture, but nursery licensing and inspection, apiary inspection and the soybean cyst nematode quarantine are independent state operations.

Division responsibilities also include formulation of rules and regulations for the guidance of inspectors in making inspections and investigations; regulation of all shipments of nursery stock into the state; and formulation and enforcement of necessary plant quarantine regulations. All subject to the approval of the Governor.

The primary purpose of the Division of State Parks is to preserve outstanding examples of Indiana's natural and scenic heritage. Secondarily and complementary to its primary responsibility, the Division is to provide associated quality outdoor recreational opportunities. Properties now owned by the state and managed by the Division in the Basin include Bass Lake State Beach and Potato Creek State Recreation Area.

An act passed by the 1967 General Assembly created a Division of Nature Preserves within the Indiana Department of Natural Resources, for the purpose of establishing a state system of these areas. It provided for their acquisition, control, use, management, and protection.

Acquisition is directed toward the purchase of certain key tracts that are in danger of being lost by timber cutting, mining, or other exploitation. Acreage will include the natural tract and a sufficient buffer zone.

Development expenditures involve fencing, concrete boundary markers, signs and outside parking lots and roads. Nature preserves are for walking only. To date, 24 nature preserves containing 5,011 acres, have been dedicated by the Natural Resources Commission. These vary in sizes from 1,530 acres in Dunes Nature Preserve in the Indiana Dunes State Park to Grider Nature Preserve with 10 acres in Tri-County State Fish and Wildlife Area. Seventeen are located on properties under the jurisdiction of the Department of Natural Resources; four are owned by Acres, Inc.; two by the Nature Conservancy and one by St. Joseph County Park and Recreation Board.

The Division of Water has primary responsibility for basin and project planning, and for the regulatory, construction and administrative phases of the water resource functions of the Department. These responsibilities include studies and investigations needed to develop projects wherein state participation is warranted and justified in order to obtain multiple-purpose development of specific small watershed and reservoir projects, and to solve specific flood control and water resources problems.

The planning program of the Division includes cooperation with state and federal agencies in investigating and planning for flood control and water resources development and planning for flood plain regulation.

The regulatory program of the Division includes review and approval or disapproval of the construction of any works in the floodways of the rivers and streams of the state; review, coordination and approval of plans and specifications for all works of any nature for flood control in the state; making engineering inspections of and enforcing proper maintenance and repair of dams, levees and floodwalls, and mediating disputes between users of surface water in any watershed area.

It also includes the review of petitions for the formation of conservancy districts; establishment of average normal water levels of natural lakes and the review and approval or disapproval of the alternation of the bed or shore line of public freshwater lakes; enforcement of laws which control removal of sand, gravel and minerals from navigable streams and from Lake Michigan; licensing of water well drillers; and issuing permits to oil operators for use of potable ground water for water-flood operations.

The construction program of the Division includes the construction or supervision of construction of dams, spillways and control works necessary to maintain the average normal level of natural and artificial lakes; planning, design and construction of flood control and water resources projects, including multiple-purpose reservoirs.

Other activities of the Division are the administration of the Flood Control Revolving Fund; development and administration of contracts for the provision of certain minimum quantities of stream flow or for the sale of water; administration of the water resources development fund, established for the purpose of developing reservoirs for water supply; reservoir sites for storage of water; administration of state contributions connected with federal multiple-purpose reservoirs; administration of State Grant Funds for the construction of multiple-purpose reservoirs in small watershed projects; and administration of the cooperative stream gaging and ground water programs, the cooperative lake level gaging station program and the cooperative lake mapping program with the U. S. Geological Survey.

The State Water Plan Section is responsible for coordination of the development of a State Water Plan for the timely conservation, utilization and management of water and related land resources, so formulated as to provide the means for satisfying the state's needs for water during the foreseeable future. The Plan will constitute one element of the Comprehensive State Plan for the physical, social and economic development of the state now being coordinated by the Department of Commerce.

The programs and activities of the Section and the cooperating agencies are to evaluate and appraise the surface and ground water resources of the state in terms of location, quantitiy and quality; evaluate and appraise existing water resources developments; develop both medium and long-range population and economic projections and translate these projections into requirements for water for all beneficial purposes; and develop and propose a plan of action, with appropriate alternatives, for the timely development and management of Indiana's water and related land resources to meet indicated needs.

The Division of Geological Survey has the responsibility to locate and describe the state's mineral resources; to determine the mineralogic and chemical composition of these deposits and their suitability for particular industrial uses; to provide other state agencies with the geologic and geophysical information that they may require to preserve in accessible form selected oil well samples, cores, electrical and other logs and mineral records and analyses; and to do basic scientific research on all phases of the geologic information that will increase the utilization of Indiana's mineral resources.

The programs of the Geological Survey include investigations of the mineral resources of the state; geochemical analysis of all geologic formations; geophysical surveys in connection with dam and spillway sites and with mapping thickness of potential aquifers. A major geologic mapping program has involved the preparation of regional geologic maps that show bedrock and surficial materials.

The State Soil and Water Conservation Committee is responsible for seeing that county soil and water conservation districts are organized throughout the state, and that these districts carry out their operations in accordance with the law. In addition to assisting local district supervisors to perform their duties, it is also responsible for maintaining permanent records for each district, making supervisor appointments, overseeing elections, securing oath of office from each supervisor, training supervisors and keeping them informed.

The purpose of the State Committee is to organize, guide and support the local soil and water conservation districts. To accomplish this, the Committee: (1) assists interested local groups in organizing new districts, (2) helps districts plan and revise their long-range programs, (3) assists supervisors with their districts' administrative, management and operational responsibilities, (4) stimulates interests and activity on the part of district supervisors, (5) assists in development of public appreciation of the problems and importance of conserving resources, (6) helps districts with their conservation education program, (7) provides conservation information to news media throughout the state, (8) apportions the state funds for district program needs, and (9) facilitates the acceleration of small watershed planning by transferring state appropriated funds to the U. S. Soil Conservation Service under a trust fund agreement.

2. State Board of Health

The State Board of Health was established in 1891 to provide an agency responsible for safeguarding the health and life of the citizens of the state. The Board must review and approve all plans for water supply improvements prior to construction and it has the authority to confer with local officials and agencies on their future needs; participate in the evaluation of existing and future sources of water supply; and supervise all municipal, county and other water supply systems. It has similar authority with respect to planning, construction and operation of all sewage systems and sewage treatment plants and plants for industrial waste treatment and disposal.

The programs and activities of the State Board of Health concerning water supply, water resources and water pollution control are best described under the division responsible for carrying them out.

The Division of Sanitary Engineering has primary responsibility for matters relating to the health and sanitary aspects of public water supplies, certain semi-public water supplies and sewage treatment facilities and solid waste disposal. The Division program includes review and approval of plans for public and certain semi-public water supplies, advice and recommendations concerning standards for design, construction and operation of public water supplies and the need for improvements and expansion of the facilities; insuring that all public and semi-public water supplies produce water meeting the bacteriological and other health-related standards set forth in the latest Public Health Service Drinking Water Standards; and advising and assisting other state, interstate and federal agencies in studies of, and programs for water supply development.

Plans for semi-public wastewater treatment which discharge to streams are reviewed, summarized and presented, with recommendation; to the Stream Pollution Control Board for their approval or disapproval.

The Division of Water Pollution Control has the main responsibility for furnishing technical assistance to and staff for the Stream Pollution Board of Health in 1968. Plans for municipal and industrial wastewater treatment facilities are reviewed, summarized and presented, with recommendations, to the Stream Pollution Control Board for their approval or disapproval. Field activities, including inspection and assistance in the operation of wastewater treatment plants, collection of data required for determination of pollution and operation of the water quality monitoring network and stream sampling, are carried on by the appropriate sections. Liaison internally within the Division and with other state, federal and local agencies and groups concerning water supply, water pollution and water resources is carried on under Special Projects.

3. Stream Pollution Control Board

The Stream Pollution Control Board which was established in 1943, has broad powers to control and prevent pollution of water in Indiana by substances injurious to public health, industry or wildlife. It is designated as the agency to represent the state in the federal water pollution control program, and it reviews plans and specifications for pollution abatement facilities and assigns priorities to municipalities for federal aid.

The primary objective of the Board is to control and prevent the pollution of surface and ground waters within the state, in accordance with state statutes, interstate compacts and federal laws. This is accomplished by eliminating existing pollution of

waters in Indiana, by requiring adequate treatment prior to discharge for all wastes from new outlets; and by urging adequate expansion of existing waste treatment facilities as the need arises due to population growth and industrial expansion.

4. Environmental Management Board

The Environmental Management Board was established by an act of the 1972 Legislature to provide for evolving policies for comprehensive environmental development and control on a statewide basis; and to unify, coordinate and implement programs to provide for the most beneficial use of the resources of the state and to preserve, protect and enhance the quality of the environment so that, to the extent possible, future generations will be insured clean air, clean water and a healthful environment.

This board shall develop and maintain a current long term comprehensive program for the state for the development and control of the total environment to insure the best possible air, water and land quality. It shall evolve standards and develop and adopt regulations to assure the accomplishment of the comprehensive long term program; conduct a program of continuing surveillance and inspection of refuse disposal sites, public water supplies, actual or threatened sources of environmental pollution by contamination, radiation, odor or noise; encourage and assist local units of government in the developing of programs and facilities for air, water, radiation, odor, and noise pollution control, water and wastewater treatment, water resource development and soild waste disposal.

The Stream Pollution Control Board and Air Pollution Control Board are continued as now established and retain their powers and duties. The establishment of priorities and coordination of the functions and services of these agencies are now conferred on this board.

This board also is vested with the powers and duties formerly exercised by the State Board of Health under the Refuse Disposal Act, the Wastewater Treatment Control Act, the Water Resources Research Act and the Sanitary Water Supply Act.

The Stream Pollution Control Board is designated as the solid waste agency for the state for all purposes of the Federal Solid Waste Disposal Act.

Each agency, department and institution of the state shall report to the board any plans or activities which may affect the environment of the state. The board shall review such reports and coordinate the programs which may affect the environment.

If the board finds that local governmental units have not developed plans which provide for adequate water supply, air, water, or wastewater treatment or solid waste disposal facilities, the board or an agency may hold a public hearing and if the facts support such conclusion, the board may order the affected local governmental units to proceed to form regional water, sewage, air, or solid waste district as may be necessary.

The board at any time, may by resolution approved by its members, transfer any duties or powers vested in it to the Stream Pollution Control Board or Air Pollution Control Board.

5. State Planning Services Agency

The State Planning Services Agency maintains two divisions, planning and economic research. The Planning Division provides local planning assistance to counties, cities, and towns. In addition, the Planning Division also prepares studies in areas of land use, transportation, housing, recreation, and environmental management through its state planning section. This Division works with city, area and regional plan commissions in developing comprehensive plans for local areas. There is a traditional variety of land use planning, resulting in regulations of use of land to insure balanced and compatible future development patterns. Comprehensive plans have been developed for all counties of The Economic Area, and for approximately 25 cities or towns of The Economic Area, most of which lie along the northern parts of Lake, Porter and LaPorte Counties outside the Basin. The Economic Research Division provides economic analysis for planning - related to problems, and educational services to inform state and local officials and private citizens on federal and state planning programs.

6. Purdue University

The Natural Resources Research Institute was established in July 1964 as an administrative unit of Purdue University to provide scientific leadership and coordinated management for all University, inter-disciplinary research and educational programs concerned with the preservation, conservation, development and utilization of the state's most important basic natural resources - water, land and the atmosphere.

The Institute has general jurisdiction over three associated research centers known as the: (1) Water Resources Research Center, (2) Land Resources Research Center, and (3) Atmospheric Resources Center. The Water Resources Center serves to coordinate and expand research programs dealing with all phases of present and future water problems. At present the University has on-going research in this field.

The off-campus teaching arm of the University is the Cooperative Extension Service. The principal areas of educational effort dealing with water use and management are in the Department of Agricultural Engineering; Agronomy; Forestry and Natural Resources; and Agricultural Economics.

7. Indiana University

A Water Resource Research Center, to integrate the diverse water research activities of Indiana University and to coordinate them with water programs of state and federal agencies, other academic institutions, and private organizations, was established as an interdisciplinary component of the University in June 1963. Emphasis is placed on water problems peculiar to the midwest, and the Center helps to identify and define those areas in which current research is deficient, and to stimulate and initiate new research programs in critical areas.

The Center for Outdoor Recreation Research of the Department of Recreation and Park Administration in the School of Health, Physical Education, and Recreation, conducts special research studies on topics pertaining to outdoor recreation, leisure time, recreation resource allocation, and other related subjects. The Center is available to conduct specific studies upon request by both public and private agencies.

D. Local and Other Agencies

There are several types of special purpose districts that may be established in Indiana to handle various water management problems. Their areas of jurisdiction and responsibility are usually tailored to specific objectives. The following paragraphs discuss local entities which may be effective in dealing with water and related soil resources in the Basin.

1. Conservancy Districts

Under the provisions of the Indiana Conservancy Act, Acts of 1957, Chapter 308, as amended, local landowners may petition the circuit courts for the establishment of conservancy districts that have the necessary legal authority and fund raising powers to construct, operate and maintain works of improvement for solving water management and water resources problems. Conservancy districts may be formed to accomplish one or more of the following purposes:

a. flood prevention and control,

b. improve drainage,

c. provide for irrigation,

d. provide for water supply, including treatment and distribution for domestic, industrial and public use,

e. provide for the collection, treatment and disposal of sewage and other liquid wastes produced within the district,

f. develop forests, wildlife areas and parks and recreational facilities where feasible in connection with beneficial water management,

g. prevent the loss of top soil from injurious water erosion,

h. storage of water for augmentation of stream flow and,

i. operation, maintenance and improvement of any existing work of improvement for water-based recreational purposes, or other work of improvement which could have been built pursuant of any of the above purposes.

The program and operation of the conservancy district may be financed by special benefit taxes levied on real property, the collection of assessments from lands which may receive exceptional benefits, the receipt of funds from federal or state government, the receipt of revenue from the sale of services or property, the collection of assessments for maintenance and operation of the works of improvement and borrowing from private or public sources. The Flood Control Revolving Fund, as mentioned previously, is one source of monies available to conservancy districts. The seven (7) conservancy districts now in existance in the Economic Area are: Bailey-Cox-Newtson (Starke County); Iroquois River (Jasper and Newton Counties); Independence Hill, Merrillville, and West Creek (Lake County); Mud River (St. Joseph County); and Valparaiso Lakes Area (Porter County).

2. Soil and Water Conservation Districts

Soil and Water Conservation Districts are established under the provisions of Acts of 1965, Chapter 171, as amended, to encourage the development, improvement and conservation of lands and water. The Board of Supervisors, assisted by technicians of the U. S. Soil Conservation Service, promotes the use of proper land treatment practices and sound farming techniques by the local landowners. They have active interests in the federal watershed protection and flood prevention program, and they have authority to construct water control and management works; however, the district does not have eminent domain, taxing or assessment powers. All counties in the Basin have active Soil and Water Conservation Districts.

Prior to 1965, Soil Conservation Districts were established under the provision of Acts of 1937, Chapter 232, as amended. This act was superseded by the Soil and Water Conservation Districts Act of 1965.

3. Regional Water, Sewage and Solid Waste Districts

Under the provisions of the Acts of 1969, Chapter 244, any area situated in any unincorporated part of one or more contiguous counties or in one or more municipal corporations, or both, may be organized as a regional water, sewage and solid waste district for one or more of the following purposes:

a. to provide a water supply for domestic, industrial and public use to users within and without the districts,

b. to provide for the collection and disposal of storm and sanitary sewage and other liquid waste within and without the district,

c. to provide for the collection and disposal of solid waste and refuse within and without the district.

The authority for the district is vested in a board of trustees which manages and conducts the affairs of the district. The board of trustees may make and enforce rules and regulations necessary to accomplish the purposes of a district which are not inconsistent with the laws of the State Board of Health or the Stream Pollution Control Board. Before taking effect, all rules and regulations, issue of bonds and proposed rates of the district are subject to approval by the Public Service Commission of Indiana. Before plans for the proper purification, filtration and distribution of water or proper collection and treatment of sewage are placed in effect they must be filed with the State Board of Health of the Stream Pollution Control Board, which may approve or reject any provisions of the plans pertaining to water supply, sewage and solid waste.

4. Planning and Zoning Commissions

Planning and zoning commissions - municipal, county and regional - are concerned with the orderly development of land. The use of lands that are subject to flooding can be controlled through zoning and other regulations that prescribe how such areas may be used or developed to minimize the loss of life and property damage from flooding. Proper drainage and adequate sanitation facilities are also of concern to plan commissions. All counties in the Economic Area have Plan Commissions now in existance. These are the Northwest Indiana Regional Planning Commission (Lake and Porter Counties), the Kankakee-Iroquois Regional Planning Commission (Newton, Jasper, Pulaski and Starke Counties), the Michiana Area Council of Governments, the St. Joseph County Area Plan Commission, and the county plan commissions in Benton, Jasper, Lake, LaPorte, Marshall, Newton and Starke Counties. In addition there are plan commissions in 13 cities and 16 towns within the Economic Area.

5. Counties, Cities and Towns

County commissioners, city councils and town boards can pass ordinances regarding water, sewage and general health which designate the health officer having jurisdiction as the enforcing agent. In addition, the local health departments are an important part of water resources development because they have authority to enforce Indiana State Board of Health laws, rules and regulations at the local level.

6. County Drainage Boards

The Indiana Drainage Code, Acts of 1965, as amended in 1969 and 1971, created in each county in the state a county drainage board for the purpose of construction, reconstruction and maintenance of all legal drains in the county. Board membership consists of the county commissioners, or a board expressly appointed by the board of county commissioners and consisting of three or five members at the discretion of the county commissioners, and together with the county surveyor, ex officio, shall constitute the county drainage board. An appointed board shall have at least one member who is a county commissioner with the remaining members being resident freeholders with knowledge in drainage matters.

Whenever construction or reconstruction of a legal open drain is proposed, the Department of Natural Resources is to be notified. Before a drain under the jurisdiction of a drainage board can be included in the final plan of a conservancy district, and when plans show that any legal drain will come within 300 feet of a levee, written approval of the Department is required. Whenever anyone desires to connect a drain carrying liquid wastes into a legal drain, written approval must be obtained from the Stream Pollution Control Board.

7. Park and Recreation Boards

The Indiana Park and Recreation Law allows city and county governments to create park and recreation boards. Such boards have been created in Lake and St. Joseph Counties and in the Basin communities of Cedar Lake, Demotte, Fowler, Hebron, Knox, Kouts, Lowell, Nappanee, Plymouth, Rensselaer, South Bend and Walkerton. Several cities and towns outside the Basin but within the Economic Area have also created park and recreation boards. This category includes Crown Point, Valparaiso and LaPorte. These boards have the authority to develop and implement county or city recreation plans.

IX. FORMULATION AND EVALUATION OF ALTERNATIVE SOLUTIONS AND ENVIRONMENTAL ASSESSMENT OF SUGGESTIONS FOR DEVELOPMENT

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CHAPTER IX
FORMULATION AND EVALUATION OF SOLUTIONS AND ENVIRONMENTAL ASSESSMENT OF SUGGESTIONS FOR DEVELOPMENT

The formulation and evaluation of opportunities for development in this Basin were guided by the USDA Procedures for Planning Water and Related Land Resources, in accordance with the Water Resources Council's "Principles and Standards for Water and Related Land Resources Planning." The Water Resources Council, an independent executive agency of the U.S. Government is composed of representatives of federal departments and commissions engaged in water resources planning and development. Under the "Principles and Standards," the overall purpose of water and related land resources planning is to promote the quality of life through contributions to the following objectives:

1) Enhancement of the national economic development (NED) by increasing the output and value of the nation's goods and services and improving national economic efficiency.

2) Enhancement of environmental quality (EQ) by the management, conservation, preservation, creation, restoration or improvement of the quality of certain natural and cultural resources and ecological systems.

Several combinations of plan elements for the use of water and related land to solve identified problems and meet identified needs of the Basin residents were evaluated. Each plan element was considered from the standpoint of its contribution to one or both of the primary objectives. Utilizing the Principles and Standards, five alternatives (groups of plan elements) were developed. The plan elements were first assigned to either the NED objective or the EQ objective (the land treatment and flood plain management were assigned to both) to form the "alternative" aligned with the respective objectives. These are labeled Alternative A - National Economic Development (NED) and Alternative E - Environmental Quality (EQ). Alternative A contains those planning elements which, if implemented, would have economic returns (beneficial effects) that exceed the costs (adverse effects), in terms of a national viewpoint. Alternative E contains those planning elements designed to enhance the natural environment of the Basin. Alternatives B, C, and D combine the planning elements contained in Alternatives A and E and represent additional alternatives which the Coordinating Committee presented to the local citizens for their consideration.

The components of each alternative are displayed, in terms of their effects, by four specific accounts. The NED account displays the dollar benefits (beneficial effects) and the costs of development. As expected, the plan development to maximize such benefits (Alternative A) performs far better in that respect than the environmentally oriented plan (Alternative E). The EQ account evaluates the effects of the planning elements on the quality of the environment, in qualitative and, where possible, quantitative terms.

The Regional Development (RD) account evaluates the economic impacts of each "alternative" on the immediate area as distinguished from the nation. Regional development, although not identified as a major objective, is extremely important to the Basin residents. These residents recognize that development within a very small area of the Basin will have minor impact on national income; however, the local economy is dependent upon continued utilization of the agricultural resources available, and upon future conservation and development of those resources. The RD account compares impacts on income, employment, and the quality of services from both the regional and national viewpoint. Because several of the planning elements would probably be financed, in part, by federal monies (which would not then be available for use elsewhere in the nation), the RD account indicates the distribution of the monetary benefits between the region and the nation.

The Social Well-Being account (SWB) evaluates such social considerations as security of life, health, safety, personal income distribution, regional employment, and population distribution including number of jobs.

The following pages contain a more specific discussion of the planning elements both individually and as assigned to the major objectives and included in the various "alternatives". The environmental assessment of the Suggested Alternative Plan is discussed and comparison tables are provided to assist the reader in determining the relative merits of each "alternative".

A. Plan Elements

Numerous specific plan elements were considered and evaluated in terms of their effectiveness in solving the identified problems, and meeting the identified needs of the Basin. These plan elements are discussed in the following pages in terms of the principal needs they satisfy such as flood protection, recreation, land treatment, protection of classified wetlands, etc.

1. Flood Protection

The Kankakee River main channel floodplain and tributary floodplains were evaluated to determine the most efficient means of reducing flood damages and improving drainage on existing cropland. The combination of elements considered are called flood protection systems, but drainage improvement is considered an integral part of each of these systems. The importance of finding a solution to flood and drainage problems for the Kankakee River and tributaries was reiterated several times in public meetings by the Basin residents. Thirteen tributaries have been determined feasible and practical for flood protection works of improvement and are included in several of the flood protection systems. These selected tributaries include:

Name	Miles of Channel work
Bailey Ditch	26.9
Barnard(Hodge) Ditch	37.8
*Benkie Ditch	4.9
*Breyfogel Ditch	6.6
*Crooked Creek	13.5
Dehaan Ditch	10.5
Hanna Arm	20.6
*Phillips-Cornell Ditch	2.6
Robbins Ditch	40.0
*Sandy Hook Ditch	18.7
Singleton Ditch	56.4
**Cook Ditch	12.2
**Marquardt Ditch	7.8

* Part of Porter County - Kankakee Watershed (PL-566) Application

** Effects not included in Chapter IX tables. See page IX - 8 for further explanation.

The 13 tributaries included for channel work are of a size compatible with the USDA Watershed Protection and Flood Prevention program (Public Law 83-566).

Current local applications for USDA assistance under the watershed program include 6 of the 13 tributaries. Plate No. 16 shows the status of potentially feasible watershed projects within the Basin including those tributaries for which applications have been submitted.

Each flood protection system was evaluated in sufficient detail to determine its practicability and/or feasibility for consideration in the various comprehensive Basin wide alternatives for development. Plan elements included in the flood protection systems were designed to provide a 1-year (2-year cropping season) level of flood protection. A greater level of protection on the main stem is not practical due to the increased flood stages that would result downstream. Increased stages downstream of channel excavation type projects result from increased discharge rates brought on by larger, more efficient channels delivering flood water that would have been temporarily stored on flood plains prior to the project. Levee type projects cause increased stages downstream by containing more flood water in and near the stream than occurs naturally. Thus, increased depths of flow result in greater discharge rates.

Channel work was designed for adequate depth and capacity for agricultural drainage on existing cropland. The five systems selected for alternative A through E are described in

detail under the discussion of the appropriate alternative. The main-stem portion of flood protection systems 2, 4A, and 7 are illustrated on Plate 18.

The ten (10) flood protection systems considered are described as follows:

No. 1 No work on main channel or tributaries

This system would not reduce the amount of present flood damage, nor would it effect a reduction of future flood damages that would result from future development within the flood plains. It serves as the "future without project" condition to which all other flood protection systems are compared.

No. 2 Channel work (clearing and excavation) on the Kankakee River from old Indiana Route 223 near South Bend to Momence, Illinois (including rock excavation at Momence). Channel work (clearing and excavation) on the 13 selected tributaries of the Kankakee River.

For the Indiana portion clearing and excavation within the existing channel is required through virtually the entire project length. Minimal bottom width widening of 20 feet, or less, but increasing depths by as much as 6 feet characterize the design channel in Indiana. Downstream of the state line channel re-alignment results in a new channel for five miles to the junction with Singleton Ditch. Illinois channel bottom width upstream of Singleton Ditch is 170 feet. From Singleton Ditch downstream through Momence the present channel bottom width and alignment is adequate for the 260 foot design. However, depth through Momence must be increased by as much as four feet into predominantly limestone rock. The 100-year discharge would be increased 30 percent and the stage by 1.5 feet at the downstream edge of Momence (Table IX-2).

Channel work on 13 selected tributaries of the Kankakee River in Indiana ranges from nominal clearing and enlargement to extensive clearing and excavation. These selected tributaries are provided gravity outlets by the above main stem channel design.

Appropriate costs have been included for mitigation of fish and wildlife habitat losses. Special construction methods, such as one-side excavation have been considered, where practical.

This system is the most efficient in producing net benefits and thereby serves as the flood control system for the NED base. It is therefore included in the NED alternative (Alternative A).

No. 3 Channel work (clearing and excavation) on Kankakee River from old Indiana Route 223 to U.S. Route 41. Channel work (clearing and excavation) on 13 selected tributaries of the Kankakee River.

This system would result in extensive destruction of natural stream habitat from clearing and excavation. The channel would be deepened as much as five feet. Very little stream widening would be required upstream from Shelby, but a very wide channel would be needed to maintain capacity as the terminus of work is approached at U. S. Route 41. At that area the existing 190 foot bottom width channel would be increased to 350 feet bottom width. Peak flood discharges increase by about 50 percent downstream of the project which induces additional flood damages to river front housing. Termination of work at U.S. Route 41 does not provide an efficient outlet for the tributary channel work included in this system. Tributary work would be essentially the same as described in system 2. The preliminary design for this system includes mitigation of fish and wildlife losses.

No. 4 Channel work (clearing and excavation) on the Kankakee River from old Indiana Route 223 to U.S. Route 30. Wide-spaced levees (no channel work) along the Kankakee River main valley from U.S. Route 30 to the state line. Channel work (clearing, excavation, levees, and pumps) on 13 selected tributaries of the Kankakee River

The unique feature is the wide-spaced levees within which no channel work is planned. Spacing between the levees is variable. The tentative placement was selected to include as little cropland as possible, to include woodland and other non-crop areas, to utilize relatively higher ground for minimizing levee costs, to avoid sharp bends and to provide as much width between levees as possible for flood storage. The land between the levees could be used for recreation and fish and wildlife purposes since no construction is planned there. Width between the levees, as studied, is 5500 feet at the state line, 3200 feet at U.S. Route 41 and ranges between 2000 feet and 4400 feet from that location to the vicinity of Dunns Bridge. Widths are less upstream and range downward to 1000 feet near U.S. Route 30 with an exception at the Kankakee State Fish and Wildlife Area where the width increases to 4500 feet. Typical levee height is between six and eight feet with the range being zero to fourteen feet. The maximum height would be infrequently required where the best route is across an unusually low spot. This measure would contain all floods up to the 100-year event but it also induces 60 percent increased peak flood discharges in Illinois. The large floods would be increased more by this measure than would smaller floods since the flood plain storage factor has more effect during large floods. The preliminary design for measure 4 includes tributary work on 13 tributaries. This work requires levees and pumps for some tributaries in addition to the general clearing and excavation required. Mitigation of fish and wildlife habitat is included in design and cost estimates.

No. 4A Same as 4 except the downstream terminus of wide levees would be at U.S. Route 41, and spillways would be provided in the levees to store water behind the levees during large floods. Channel work (clearing and excavation) on 13 selected tributaries of the Kankakee River.

The wide-spaced levees in this system are not as high as the levees of system 4, and they contain spillways to release flood water to the landward side during events larger than the 1-year. Therefore, this system provides a 1-year level of protection and permits the flood water of the large storms to be stored in the flood plains as in existing conditions. The width between levees would be similar to system 4. The height of the levees would range from 2 to 4 feet. The preliminary design for system 4A includes channel work on 13 selected tributaries. This work includes levees and pumps for some tributaries in addition to clearing and excavation. Mitigation of fish and wildlife habitat losses is included. One-side excavation, where practical, is also included to reduce adverse environmental effects.

This system is included in Alternate B.

No. 5 Channel work (clearing and excavation) on Kankakee River from old Indiana Route 223 to U.S. Route 30. Narrow-spaced levees along the Kankakee River and minor channel work from U.S. 30 to the state line. Channel work (clearing and excavation) on 13 selected tributaries of the Kankakee River.

Design features for system 5 include reconstructing the Kankakee River in Indiana and placement of levees near the channel banks. System 5 would result in destruction of large areas of natural stream habitat from clearing, excavation and levee construction. The hydraulic effect would be to double flood discharges in Illinois. This undesireable effect results from containment of flood volumes within the levees normally stored temporarily on flood plains, and from channel clearing and excavation which increase flow velocity. Tributary work would be essentially the same as described in system 2. The design for system 5 includes mitigation of fish and wildlife habitat losses.

No. 6 Channel work (clearing and excavation) on the Kankakee River from old Indiana Route 223 to U.S. Route 30. Wide-spaced levees along the Kankakee River main valley (no channel work) from U.S. Route 30 to the state line. New channel construction north and south of the wide-spaced levees between Yellow River junction and the state line. Channel work on 13 selected tributaries of the Kankakee River.

Preliminary design features for system 6 include new channels outside the wide levees to convey tributary discharges. This placement of new channels avoided construction work between levees but would require large scale clearing and earthwork for the levees and channels. High costs for new road structures and increased flooding in Illinois would result.

No. 7 No work on Kankakee River below U.S. Route 30. Channel work (clearing and excavation) on Kankakee River from old Indiana Route 223 to U.S. Route 30. Channel work (clearing and excavation) on 13 selected tributaries of the Kankakee River.

This system is included in Alternate C and includes minor widening (up to 20 feet) and deepening. Channel work on the 13 tributaries ranged from nominal clearing and enlargement to extensive clearing and excavation. Levees and pumps are required for some of the tributaries. Mitigation of fish and wildlife habitat losses is included. Also, special construction methods, such as one-side excavation, are included in the preliminary design.

No. 8 No work on the Kankakee River. Channel work on (clearing and excavation) 13 selected tributaries of the Kankakee River.

This system is included in Alternative D. The channel work is similar to that described under system 7. Provisions are included for mitigating fish and wildlife habitat losses.

No. 9 Non-structural alternate to include local flood plain regulations to enforce zoning ordinances, building codes, and land uses compatible with flood hazard areas and to allow eligibility for flood insurance.

This system (No. 9) is included in the EQ alternative (Alternative E).

The flood protection systems were assessed in varying detail, due largely, to the wide range of effects apparent from that portion of each system relating to the Kankakee River main stem. Flood control system 1 serves as the "future without project" condition to which all other flood protection systems are compared. System No. 2 is the most efficient in producing net benefits and thereby serves as the flood protection system for the NED base and is included in the NED alternative (Alternative A). Flood protection systems 3, 4, 5 and 6 are not included in the alternative plans for the Basin because substantial increased flooding immediately downstream and into Illinois is unacceptable to residents downstream from the end of work in both Indiana and Illinois.

Other objectional features include an excessively wide channel near U.S. Route 41 in system 3, excessive volumes of water that must be conveyed between the levees of system 5, and excessive cost of roads and bridges required for new channel crossings of system 6.

Flood protection systems 2, 3, 4A, 7, 8, and 9 do provide net beneficial effect, in monetary terms. Average annual costs and benefits, and fixed costs for each system are displayed in Table IX-1. The average annual benefits to drainage include efficiency gains only at existing levels of production. Benefits which would accrue to increased production resulting from improved drainage conditions are not included on Table IX-1 nor the NED accounts of each alternative. Flood protection systems 2, 4A, 7, 8, and 9 are discussed in more detail and displayed in the various Basin alternatives (A through E). Effects of each flood protection system in terms of flood elevations and discharges at the stream gages, are shown in Table IX-2.

In regard to the tributaries, additional major tributaries were analyzed to determine their feasibility for reducing major flood and drainage problems on agricultural lands. Those tributaries, which are listed in Table V-5, have definitive flooded areas and adjacent areas on which drainage is restricted. Preliminary analyses of those areas indicate that the amount of cropland affected and the potential for reduction of annual flood damages, together with increased efficiencies of agricultural production at increased production levels, will not support major channel work for flood control and drainage purposes.

All tributaries were analyzed with consideration of additional benefits which would accrue solely to the region due to increased production levels. In all cases but two, benefits appear to be insufficient to support major flood control and drainage work. In the case of Marquardt Ditch and Cook Ditch, these additional local or regional drainage benefits from increased crop production would provide net beneficial effects; however, since OBERS Series C projections indicate the Basin can meet its share of national needs for agricultural products without additional developments, these two areas were not initially included among the plan elements for the NED alternative (A). More recent analyses, based upon OBERS Series E projections, indicate that the region's share of national needs for food and fiber will not be exceeded by including these two tributaries for development. Benefits from these potential project areas are now considered eligible for inclusion in the NED alternative. Therefore, they are included in Alternatives A (NED), B, C, and D; although Tables IX-1, IX-5, IX-7, IX-8, and IX-9 do not reflect their effects.

TABLE IX - 1. COMPARISON OF FLOOD PROTECTION SYSTEM 1/
Kankakee River Basin, Indiana

Kankakee River Flood Protection System	MAIN CHANNEL			TRIBUTARIES (11 selected) 3/			Levees and Pumps
	Average Annual Agricultural Benefits	COSTS Fixed	COSTS Annual 4/	Average Annual Agricultural Benefits	COSTS Fixed	COSTS Annual 4/	
1 2/	—	—	—	—	—	—	—
2	2,890,920 6/	28,659,200 5/	1,800,900 5/	1,987,310 9/	16,881,290 5/	1,154,760 5/	Dehaan Ditch Bailey Ditch
3	2,826,460 7/	34,991,900 5/	2,186,100 5/	1,987,310 9/	16,881,290 5/	1,154,760 5/	Dehaan Ditch Bailey Ditch
4A 26 miles channel	864,970 8/	6,481,000	407,700	1,987,300 9/	16,446,800 12/	1,100,600 12/	Eight (8) Tributaries
4A 49 miles levees	1,728,930 10/	23,734,300	1,620,700				
4A Total (combined system)	2,593,900 11/	30,215,300 12/	2,028,400 12/				
7	864,970 8/	6,481,000 12/	407,700 12/	1,987,300 9/	18,565,400 12/	1,292,700 12/	Bailey Ditch Hanna Arm Barnard Ditch Dehaan Ditch
8	—	—	—	1,987,300 9/	18,565,400 12/	1,292,700 12/	Bailey Ditch Hanna Arm Barnard Ditch Dehaan Ditch
9	Non-structural - Applicable to 100-year flood plain (main stem and tributaries) Annual Benefits Future Non-agricultural Damage Reduction = $155,000 Annual Costs = $ 89,000						

1/ Benefits to drainage include only efficiency gains at existing levels of production(increased production benefits are excluded).
2/ No work - Future Without Project Condition.
3/ Figures do not reflect the addition of Cook Ditch and Marquardt Ditch.
4/ Average Annual Costs include fixed costs ammortized at 6 1/8 percent for 100 years plus operation, maintenance and replacement(O,M,&R) costs.
5/ Does not include potential induced flood damages downstream from end of work.
6/ Excludes $782,100 increased production benefits (drainage).
7/ Excludes $758,400 increased production benefits (drainage).
8/ Excludes $197,500 increased production benefits (drainage).
9/ Excludes $575,800 increased production benefits (drainage).
10/ Excludes $534,200 increased production benefits(drainage).
11/ Excludes $731,700 increased production benefits(drainage).
12/ Includes costs required to eliminate induced damages.

TABLE IX - 2: KANKAKEE RIVER MAIN STEM-FREQUENCY DATA BY FLOOD PROTECTION SYSTEM

Kankakee River Basin, Indiana

GAGE LOCATION AND SYSTEM	100-YEAR PEAK	100-YEAR ELEV	10-YEAR PEAK	10-YEAR ELEV	2-YEAR PEAK	2-YEAR ELEV	1-YEAR PEAK	1-YEAR ELEV	REFERENCE FLOODS	
	Cfs	msl	Cfs	msl	Cfs	msl	Cfs	msl	msl	date
North Liberty										
1,8	800	690.6	680	689.5	565	688.5	495	687.8	688.9	'54
2,3,4A,7	3300	689.9	2240	688.2	1400	686.6	955	685.5	687.7	'50
Davis										
1,8	1800	678.1	1460	676.9	1225	675.9	1100	675.4	676.5	'54
2,3,4A,7	5500	677.0	4230	675.4	3120	673.6	2570	672.6	675.3	'50
Dunn's Bridge										
1,8	5900	663.7	4700	662.4	3660	660.9	3140	660.0	663.3	'54
2,3	11600	662.2	9480	660.6	7220	658.7	6160	657.6	662.3	'50
4A	5900	663.7	4700	662.4	4300	662.0	4100	661.7		
7	7350	664.5	5400	663.1	3900	661.5	3300	660.5		
Shelby										
1,8	7200	640.7	5450	639.2	4325	638.1	3750	637.4	638.3	'54
2	12500	640.3	9600	638.4	7800	637.0	6830	636.1	638.6	'50
3	13000	638.6	10000	637.5	8000	636.6	7100	636.0		
4A	7200	640.7	5800	639.6	5740	639.5	5670	639.4		
7	8000	641.1	5840	639.6	4600	638.3	3930	637.6		
Momence										
1	11850	615.6	8800	614.5	6500	613.5	5280	613.0	613.2	'54
2,3	15500	617.1	12300	615.8	9600	614.8	8250	614.3	615.3	'50
4A	12400	615.8	9350	614.7	8000	614.1	7550	613.9		
7,8	12400	615.8	9350	614.7	6850	613.7	5560	613.1		

In addition to the drainage problem areas addressed by these flood protection systems, many additional cropland areas are recognized as having severe drainage problems which are localized to one or a very few landowners. These areas should be given priority when considering continuation of agricultural production; however, they should be pursued through individual and/or small group effort. Increased efficiencies in production by agricultural drainage at existing levels of out-put contribute substantially to the national economic development. The installation of these recognized drainage systems will help satisfy needs expressed vocally by many Basin residents. Pumping many of these small drainage problem areas is a viable alternative which should be pursued through individual or group effort.

2. ACCELERATED LAND TREATMENT

Land treatment measures are conservation practices which are needed to protect the basic soil resource and provide optimum returns within the physical constraints of soils and topography. The land treatment program is divided into two categories for this report. One category includes adequate treatment on 426,400 acres of existing agricultural and forest land for erosion control and increased production efficiency. This portion of the land treatment program consists of those measures needed to adequately treat about 65 percent of the land. Table IX-3 indicates the estimated accomplishments and cost for this portion of the recommended accelerated land treatment program. The other category of the land treatment program includes the installation of on-farm drainage systems for improved efficiency of agricultural production on about 330,000 acres of existing cropland. These drainage measures are not dependent upon the plan elements discussed under flood protection. The 330,000 acres represent about 75 percent of the identified need.

3. RECREATION

The recreation plan elements include provisions for "county type" parks, regional parks, riverside recreation developments, canoeing, a system of trails for hiking and bicycling, and trails for horseback riding. The elements included in the various alternatives should be assessed in terms of the recreation needs identified for the Economic (9-county) Area. The park areas could involve some existing cropland; however, the locations and installation of such parks will require local decisions and actions as to the type of land uses which may be affected by park developments. The development of county and regional parks is a recognized need in the State Recreation Plan. The "county type" park areas are included to help meet the needs for additional recreational opportunities and to provide varying intensities of use for a variety of activities. It is anticipated that these parks would follow

TABLE IX - 3. ACCELERATED LAND TREATMENT PROGRAM-ACCOMPLISHMENTS BY 1990 1/
Kankakee River Basin, Indiana

Conservation Treatment Practices	Acres Needing Treatment 2/	Acres to be Treated	Accelerated Land Treatment Cost ($1,000)
Cropland			
Crop Residue Management	209,320	156,970	582.4
Sod in Rotation	121,470	91,100	-
Contour Farming	16,870	12,650	25.3
Stripcropping, Terracing or Diversions	81,910	61,430	7,227.5
Permanent Cover	35,900	26,926	1,408.9
Technical Assistance			2,118.1
Grassland			
Protection Only	6,790	5,090	12.7
Improvement Only	24,010	18,010	540.2
Brush Control & Improvement	9,020	6,770	338.3
Reestablish Vegetative Cover	8,420	6,320	252.6
Reestablish with Brush Control	30, 820	23,120	1,155.8
Technical Assistance			82.1
Forestland 3/			
Management Plans		9,000	36.0
Timber Stand Improvement	61,100	3,500	98.0
Forestland Grazing Control	30,900	9,000	225.0
Establishment and Reinforcement Tree Planting	21,600	450	20.7
TOTAL - Early Action Program			14,123.6

1/ Included in the NED Alternative, Alternative B, C and D and the Selected Plan

2/ Based on Indiana Soil and Water Conservation Needs Inventory - 1968

3/ Costs include technical assistance

the development format of the typical county parks. It is anticipated that 8 to 16 parks would be developed adjacent to natural water and would involve about 6,400 acres. Locations have not been chosen and would be decided by local sponsoring organizations such as county park and recreation boards. Activities could include camping, picnicking, hiking, golf, and other sports associated with playfields or playgrounds. The type and intensity of development and activities planned would be determined by the local sponsoring organizations.

The regional parks would be similar to the county parks except that they would be developed on a larger scale to meet the demands of a multi-county area. About 2,000 acres are included in this element.

A riverside recreational development is proposed for the Kankakee River. As included in the report, the riverside area would satisfy the aesthetic recreational activity needs such as hiking, bicycling and canoeing. The intensity of development could be low with limited picnicking areas. It is anticipated that this type of development could be compatible with the Lake County recreation plan. This element is planned for about 900 acres of Kankakee River flood plain.

Canoeing and bridle trails are identified public recreational needs in the Basin. The streams identified for canoeing have perennial water flow and offer excellent natural beauty along the stream courses. The stream channels will require limited debris and/or sandbar removal to provide for continuous canoe passage. The channel work will provide more uniform flow in the streams. Specific locations for debris and sandbar removal have not been identified as part of the study. Reconnaissance of the channels and reports from local officials indicate the need for such work. On-site investigations and decisions by local sponsors and officials should dictate the intensity of development of public canoe runs and related channel work. The canoe runs are identified for 43 miles of the Kankakee River between Indiana Route 8 and U.S. Route 41, 41 miles of the Yellow River between Plymouth and the mouth, and 28 miles of the Iroquois River between Rensselaer and the state line. Public launching sites are included for each 10 miles of stream.

Bridle trails along the Iroquois River will offer a unique experience for those horseback riding enthusiasts in the Basin who have expressed an interest in this type of recreation activity. The areas along the Iroquois River appear to be ideal for such trails. It is anticipated that no existing cropland areas would be affected. Bridle trails are included for 20 miles along the Iroquois River from western Jasper County to the state line and 50 miles of the Kankakee River between U.S. Route 30 and 41. The bridle trails could be developed in conjunction with flood control work along the Kankakee River Main Stem.

The system of trails from the Kankakee River to selected natural and urban areas are included to provide for public enjoyment of the natural and aesthetic qualities of the natural areas and the linear areas along stream courses. The trails should be developed and maintained in a condition that can enhance man's enjoyment of the existing areas of scenic beauty, wildlife habitat, natural areas, and open space. Recreational activities would be limited to bicycling, hiking, and use of nature trails. Primitive camping and picnicking could be considered when such trails are developed. Some of the trails could be developed in conjunction with flood control measures such as channel work and levee construction. In many cases, existing roadways could be utilized. Decisions of local sponsors will be necessary to determine locations and implementation plans. The 198 miles of trails as located on Plate 19 includes about 74 miles along the Kankakee River from U.S. Route 41 to Pine Creek and from Pine Creek to the Potato Creek Recreation Area. Approximately 124 remaining miles consist of several trails extending between major towns and the Kankakee River and between natural areas and the Kankakee River or major communities.

It is envisioned that these 124 miles may include the following:

a) Crown Point to Kankakee River near Route 55.

b) Valparaiso to the Kankakee River.

c) Plymouth to the Kankakee River.

d) Beaver Lake* area to the Kankakee River.

e) Kankakee River to Jasper-Pulaski State Game Preserve including Prairie Border and Bird Marsh Natural Areas*.

f) Potato Creek Recreational Area to South Bend.

g) South Bend to Bendix Woods Natural Area*.

h) Bendix Woods to LaPorte.

i) LaPorte to Kankakee River near Route 35.

It is anticipated that these trails would make use of existing trails and county roads, where available. New trails would be constructed in some areas, particularly along the Kankakee River.

* Natural Areas are located on Plate 15.

4. PROTECTION OF CLASSIFIED WETLANDS AND WOODLAND HABITAT

The protection of classified wetlands and woodland habitat is recommended in recognition of these unique natural areas within the Basin. They are less prevalent within this region than in northeastern Indiana. Woodlands, in particular, are found primarily along water courses or in planted woodlots. The habitats provided by these areas provide abundant shelter and food for a variety of wildlife. The method of protection or preservation of these woodlands and wetlands will depend upon coordinated efforts and interests of local, state, and federal agencies and landowners affected. Both voluntary effort and local initiative must be present for a program of this nature to be successful.

Many of the classified wetlands are now protected to a large extent in that policy prevents the use of federal funds in projects which would destroy them. This proposal goes beyond that, in suggesting a purchase or lease program to provide a more positive and complete degree of protection for 10,000 acres of classified wetlands. (See Plate 12 for location of existing wetlands). The woodland habitat could be protected by a tax incentive program such as the "Classified Forest" program in Indiana. Approximately 140,000 acres are proposed for the woodland habitat protection program.

5. CHANGED LAND USE

This element provides for converting 25,300 acres of severe erosion and drought hazard cropland (Classes IV, VI and VII) to non-cropland uses for reduction of erosion and sedimentation and for adequate treatment of land within its capability. This conversion would be in addition to that included in the accelerated land treatment program.

6. FISH AND WILDLIFE HABITAT PROTECTION

The Division of Fish and Wildlife, IDNR, has categorized all streams in the Basin as to their relative value for riparian wildlife habitat and fishery habitat. The recommendations for preservation and/or enhancement of the 635 miles of stream are to assure continuation of desirable wildlife and fisheries habitat. There is no intent to imply public use and/or ownership for these areas. The implementation of these recommendations will require technical and financial assistance from state and/or federal agencies charged with these responsibilities. Implicit in this recommendation is the cooperation by landowners along these streams and their willingness to recognize the value of the riparian habitat. No land purchase or use of cropland is intended with this element. Included in this element is a program for protection and maintenance of 220 miles of stream fisheries and wildlife habitat classified as fair to

excellent on Plates 13 and 14. Also included is a program for stream fisheries and wildlife on 415 miles of stream classified as poor to fair on Plates 13 and 14.

7. FLOOD PLAIN MANAGEMENT

The non-structural approach to floodplain management is recommended as a means of maintaining land uses compatible with the hazard involved. Acceptable uses of such areas are considered to be agricultural, recreational, or natural and scenic. The relatively low intensity of present development in the flood prone areas provides opportune timing for initiating local controls on land use in flood hazard areas. Existing state rules and regulations for floodway fringe areas should become part of any local ordinance governing land use and development in these areas. The non-structural method of floodplain management is considered a viable means of preventing future flood damages which might occur if improper development takes place. This program would involve about 220,000 acres of flood plains in the Basin.

8. PRESERVATION OF NON-CROPLAND FLOOD PLAIN AREAS ALONG THE KANKAKEE RIVER

The floodplain area along the Kankakee River between U.S. Route 30 and U.S. Route 41 includes about 14,000 acres of non-cropland and non-urban land. Trees, shrubs, and grasses abound on the lands situated close to the Kankakee River with many areas in a wet marsh condition. These areas have somewhat unique wildlife habitat and natural area values and are recommended for protection in their present state for the environmental quality objective.

B. Formulation of Alternatives

In order to assist the citizens in providing input into the selection of a plan for the Basin and, at the same time, adhere to the Water Resources Council guidelines, 5 alternatives were formulated for the development of water and land resources in the Basin. In so doing, the plan elements were first assigned to either the NED or the EQ objective (the land treatment and flood plain management elements were assigned to both) to form the alternative aligned with the respective objectives. These are labeled Alternative A (NED) and Alternative E (EQ). To iterate, Alternative A contains those plan elements which, if implemented, would have economic returns (beneficial effects) that exceed costs in terms of a national viewpoint. Alternative E contains those plan elements designed to enhance the natural environment of the Basin.

Alternatives B, C and D represent mixes of elements of various intensities so that in moving from B to D one is considering more environmentally oriented alternatives. Conversely, as one moves from D to B, he encounters alternatives aligned more toward economic development. In other words, Alternative C represents an appropriate balance between the NED and EQ Alternatives.

In terms of flood control, each Alternative A through E contains a different flood protection system. In other words, Alternative A includes flood protection system 2, Alternative B contains flood protection system 4A, Alternative C contains flood protection system 7, Alternative D contains flood protection system 8 and Alternative E contains flood protection system 9.

In terms of other needs such as land treatment, recreation etc., the plan elements remain essentially the same with the exception that quantities vary. For example, the on-farm drainage element is designed to meet 75 percent of the identified need in Alternative A, 56 percent in Alternative B, 38 percent in Alternative C, 19 percent in Alternative D, and zero percent in Alternative E.

Tables IX-4 displays the array of Alternative A through E and the plan elements assigned to each. The plan elements contained in each alternative are discussed in greater detail under the respective alternative.

1. National Economic Development (NED) and Environmental Quality (EQ) Alternatives.

   a. National Economic Development Objective - Alternative A

      Component needs identified with the NED objectives are in four (4) general categories:
      1. Flood damage reduction on 180,100 acres of existing cropland.
      2. Improve efficiencies in production by agricultural drainage on 439,350 acres of existing cropland.
      3. Accelerated land treatment to reduce erosion and increase production efficiency on 683,300 acres of cropland, grassland and forestland.
      4. Additional outdoor recreation opportunities including 1479 miles of trails, 2824 acres for camping, 326 miles of canoeing, 3885 acres for golfing, 2482 acres for playfields, 133,00 acres for hunting, 325 acres for picnicking, 49,600 acres for boating, and 38,225 acres for water skiing.

TABLE IX-4 ARRAY OF PLAN ELEMENTS

Kankakee River Basin, Indiana

Elements	Alternatives A (NED)	B	C	D	E (EQ)
FLOOD PROTECTION CHANNEL WORK AND/OR LEVEES					
Kankakee River	82 miles channel work (Rt. 223 to Momence, Ill.)	26 miles channel work (Rt. 223 to Rt. 30) 49 miles wide levees (Rt. 30 to Rt. 41)	26 miles channel work (Rt. 223 to Rt. 30)	-----	-----
Tributaries	238 miles channel work	238 miles channel work	238 miles channel work	238 miles channel work	-----
ACC. LAND TREATMENT Erosion Control and Increased production Efficiency (Acres)	426,400	426,400	426,400	426,400	426,400
On-Farm Drainage (Ac.)	330,000	247,500	165,000	82,500	-----
RECREATION					
County Parks (Ac.)	6,400	4,800	3,200	1,600	-----
Regional Parks (Ac.)	2,000	1,500	1,000	500	-----
Riverside Development (Ac.)	900	900	450	450	-----
Canoeing (Miles)	112	112	112	112	-----
Hiking - Bicycling Trails (Mi.)	198	74	37	37	-----
Bridle Trails (Mi.)	20	70	20	20	-----
PROTECTION OF CLASSIFIED WETLANDS (Acres)	-----	-----	-----	5,000	10,000
PROTECTION OF WOODLAND HABITAT (Acres)	-----	-----	50,000	100,000	140,000
CHANGE LAND USE for erosion control and land treatment (Ac.)	-----	-----	12,650	12,650	25,300
FISH & WILDLIFE HABITAT PROTECTION (Miles)	-----	-----	63	254	635
FLOOD PLAIN MANAGEMENT Ordinances, etc. (Ac.)	222,000	222,000	222,000	222,000	222,000
FLOOD PLAIN NATURAL AREA PRESERVATION (Ac.)	-----	-----	-----	-----	14,000

Elements assigned to the NED objective to help satisfy the identified component needs 1/ are:

1. Channel work on 82 miles of the Kanakee River from Indiana State Highway Route 223 in St. Joseph County, Indiana to Momence, Illinois, for flood prevention and drainage.

2. Channel work on 13 selected tributaries of the Kankakee River in Indiana, for flood prevention and drainage, as follows:

	Name	Miles
	Bailey Ditch	26.9
	Barnard(Hodge) Ditch	37.8
2/	Benkie Ditch	4.9
2/	Breyfogel Ditch	6.6
2/	Crooked Creek	13.5
	Dehaan Ditch	10.5
	Hanna Arm	20.6
2/	Phillips-Cornell Ditch	2.6
	Robbins Ditch	40.0
2/	Sandy Hook Ditch	18.7
	Singleton Ditch	56.4
3/	Cook Ditch	12.2
3/	Marquardt Ditch	7.8

3. Accelerated land treatment program which includes installation of on-farm drainage systems to adequately treat 330,000 acres of existing cropland.

4. Accelerated land treatment program which includes installation of conservation measures to adequately treat 426,400 acres of cropland, grassland, and forestland.

5. Provide 6,400 acres of county parks and 2,000 acres of regional parks near or adjacent to existing water areas to satisfy a variety of recreational needs.

6. Provide riverside recreation development on about 900 acres along the Kankakee River in Lake County between U. S. Route 41 and the state line.

7. Provide public access for canoeing on the Kankakee River (43 miles - Ind. Route 8 to U.S. Route 41), Yellow River (41 miles - Plymouth to the Kankakee River), and Iroquois River (28 miles - Rensselaer to the state line) with public launching sites provided for each 10 miles of stream.

1/ Component needs refers to the type, quantity and quality of desired beneficial effects.
2/ Part of Porter County-Kankakee Watershed (P1-566) Application.
3/ Not included in Table IX-5, See page IX-8 for further explanation.

8. Develop about 20 miles of bridle trails along the Iroquois River from western Jasper County to the state line.

9. Establish 198 miles (240 acres) of trails for bicycling, hiking, and nature walks along the Kankakee River from the river to natural areas such as New Oak Bog, Beaver Lake Prairie Border, Bird Marsh, and Bendix Woods (see p. III- for descriptions) and from the river or natural areas to urban centers such as Crown Point, Valparaiso, LaPorte and South Bend.

10. Amend or adopt flood plain zoning ordinances, building codes, and similar regulations for all identified flood prone areas in the Basin and allow eligibility for flood insurance.

These elements are summarized to Table IX-5 as Alternative A - National Economic Development.

Flood protection system 2 is considered the most efficient in producing net benefits and as such is included in the NED Alternative. Table IX-2 indicates 1.3 to 1.5 feet of flood stage increase at the Momence, Illinois stream gage, located <u>downstream</u> from the end of work.

The Plan Formulation Subcommittee recognized that this flood protection system would not be favorably received in Illinois because of the induced stages. Because of the remote possibility that flood protection system 2 would be chosen as a selected element, potential induced damages downstream from Momence,Ill. have not been evaluated in detail. Neither have flood damage reduction benefits that are expected to accrue between the state line and Momence been evaluated. However, preliminary studies indicate that approximately 75 buildings and 5,000 acres downstream from Momence, Ill. would be affected by the induced flooding. The estimated cost of floodproofing or relocating the buildings, and the purchase of flowage easements is estimated at $750,000. Therefore, with consideration for downstream induced damages added, flood protection system 2 clearly provides the greatest net beneficial effect (in monetary terms) and serves as a base to which other systems may be compared. It is considered appropriate, therefore, to include flood protection system 2 as an NED plan element

System 2 is designed for the maximum efficiency of water flow and includes deepening (including rock excavation at Momence) and/or widening of the Kankakee River and portions of the 13 selected tributaries. Appropriate costs have been included for stability of the stream banks and for on-site mitigation of fish and wildlife habitat losses. Construction methods, such as one-side excavation where practical, have been considered in

TABLE IX - 5: ALTERNATIVE A - NATIONAL ECONOMIC DEVELOPMENT

NATIONAL ECONOMIC DEVELOPMENT ACCOUNT

Components	Measures of Effects 1/ (Average Annual) ($1,000)	Components	Measures of Effects (Average Annual) 2/ ($1,000)
Beneficial Effects		Adverse Effects:	
A. The value to users of increased outputs of goods and services		A. The value of resources required for implementation of elements	
1. Flood prevention	1,497.1	1. Multipurpose channel work	
2. Drainage	10,690.5	Installation	2,513.7
3. Recreation	4,005.3	Land Rights	282.9
		OM&R	159.1
		2. On-farm drainage systems 3/	
		Installation	3,440.8
		OM&R	1,105.5
		3. Recreation	
		Installation	421.4
		Land Rights	577.7
		OM&R	504.4
		4. Floodplain Management Program	
		Flood prone area identification	49.1
		Program administration	40.0
Total beneficial effects	16,192.9	Total adverse effects	9,094.6
		Net beneficial effects	7,098.3

1/ Accelerated land treatment program for erosion control and increased production efficiency not evaluated in monetary terms. Total installation cost estimated to be $14,123,600

2/ Installation costs amortized for 100 years @ 6 1/8 percent interest. Includes program administration.

3/ Portion of accelerated land treatment program.

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TABLE IX - 5 (cont): ALTERNATIVE A - NATIONAL ECONOMIC DEVELOPMENT

ENVIRONMENTAL QUALITY ACCOUNT

Components	Measures of Effects
Beneficial and adverse effects:	
A. Areas of natural beauty	1. Preserve 222,000 acres of floodplain for natural or recreational uses. 2. Provide 2800 acres of protected area for wildlife. 3. Disrupt tranquility of rural environment by providing public access and recreation activities for 3,362,000 recreation visits.
B. Quality considerations of water, land and air resources	1. Reduce bank erosion on 320 miles of stream. 2. Decrease agricultural nutrient contribution to streams. 3. Extend public access to 112 miles of stream for canoeing and fishing. 4. Change 9,415 acres from private to public ownership. 5. Adequately treat about 426,000 acres to reduce erosion and increase production efficiency of agricultural land. 6. Remove 4,200 acres from crop production. 7. Improve water quality by reducing erosion and sedimentation, and by increasing infiltration and reducing storm run-off.

Components	Measures of Effect
C. Biological resources and selected ecosystems.	1. Disrupt aquatic ecosystem on 320 miles of stream. 2. Continued maintenance on 320 miles of riparian wildlife habitat. 3. Establish 1,450 acres of permanent wildlife cover. 4. Protect permanent easement on 640 acres of existing wildlife habitat. 5. Increase quantity and improve quality of wildlife habitat through land treatment program. 6. Temporary disruption of aesthetic quality and temporary increase in fire hazard from Timber Stand Improvement practices.
D. Irreversible or irretreivable commitments of resources.	1. Change 210 acres of riparian wildlife habitat to open channel or grass. 2. Replace 688 acres of wildlife habitat with public recreation facilities.

TABLE IX - 5 (cont): ALTERNATIVE A - NATIONAL ECONOMIC DEVELOPMENT

REGIONAL DEVELOPMENT ACCOUNT

Components	Measures of Effects 1/ Region 2/ (Average Annual) ($1,000)	Rest of Nation
Income:		
Beneficial effects:		
A. The value of increased output of goods and services to users residing in the region.		
1. Flood prevention	1,497.1	-
2. Drainage	14,665.3	-3,974.8
3. Recreation	4,005.3	-
4. Additional wages and salaries accruing to the region from implementation of the plan.	3,012.9	-3,012.9
B. The value of output to users residing in the region from external economies.		
1. Indirect and induced activities associated with increased net returns from drainage	3,470.0	-3,470.0
Total beneficial effect	26,650.6	-10,457.7

Components	Measures of Effects Region (Average Annual) ($1,000)	Rest of Nation 3/
Income:		
Adverse effects:		
A. The value of resources contributed from within the region to achieve the outputs.		
1. Multipurpose channel work		
Installation	628.4	1,885.3
Land Rights	282.9	-
OM&R	159.1	-
2. On-farm drainage 4/ systems		
Installation	3,440.8	-
OM&R	1,105.5	-
3. Recreation Areas		
Installation	193.1	228.3
Land Rights	288.9	288.8
OM&R	504.4	-
4. Floodplain Management Program		
Flood-prone area identification	-	49.1
Program administration	40.0	-
B. Losses in output resulting from external diseconomies, associated with land rights required for recreation.	186.5	-186.5
Total adverse effects	6,829.6	2,265.0
Net beneficial effects	19,821.0	-12,722.7

1/ Accelerated land treatment program for erosion control and increased production efficiency (exclusive of drainage) not evaluated in monetary terms.
Total installation cost estimated to be $14,123,600.

2/ Includes Indiana Planning Regions 1, 2 and 4. See page III for the counties involved.

3/ Installation costs amortized for 100 years @ 6 1/8 percent interest. Includes program administration.

4/ Portion of accelerated land treatment program; not included in Table IX-3.

Kankakee River Basin, Indiana
May 1976

TABLE IX - 5 (cont.): ALTERNATIVE A - NATIONAL ECONOMIC DEVELOPMENT

REGIONAL DEVELOPMENT ACCOUNT

Components Employment Beneficial effects:	Measures of Effects Region	Rest of Nation	Components- Employment Adverse effects:	Measures of Effects Region	Rest of Nation
A. Increase in number and types of jobs					
1. Agricultural employment	298 man-years in agricultural production	-			
2. Land treatment installation 1/	560 man-years skilled jobs	-			
	1980 man-years semi-skilled jobs	-			
	690 man-years unskilled jobs	-			
3. Land treatment OM&R 1/	51 permanent semi-skilled jobs	-			
4. Recreation Service Sector	11 permanent seasonal semi-skilled jobs	-			
	12 permanent seasonal unskilled jobs	-			
5. Project construction	340 man-years skilled jobs	-			
	1224 man-years semi-skilled jobs	-			
	305 man-years unskilled jobs	-			
6. Project OM&R	7 permanent semi-skilled jobs	-			
	2 permanent skilled jobs	-			
Total beneficial effect	900 man-years skilled jobs	-			
	3204 man-years semi-skilled jobs	-			
	995 man-years unskilled jobs	-			
	58 permanent semi-skilled jobs	-			
	12 permanent seasonal unskilled jobs	-			
	11 permanent seasonal semi-skilled jobs	-			
	2 permanent skilled jobs	-			

1/ Includes on-farm drainage systems

TABLE IX - 5 (cont.): ALTERNATIVE A - NATIONAL ECONOMIC DEVELOPMENT

SOCIAL WELL-BEING ACCOUNT

Components	Measures of Effects
Beneficial and adverse effects:	
A. Real income distribution	1. Create 58 low to medium income and 2 higher income permanent jobs for region residents.
	2. Create 23 low to medium income permanent seasonal jobs for region residents.
	3. Create 5099 man-years of jobs.
	4. It is estimated that regional income of $26,650,600 and regional costs of $6,829,600 will accrue in about the same proportion as the following income class distribution:

Income Class (dollars)	Percentage of Adjusted Gross Income in Class
Less than 3,000	7
3,000 to 10,000	40
More than 10,000	53

Components	Measures of Effects
B. Life, health and safety	1. Provide 75 percent and 45 percent flood damage reduction to the Kankakee River Main Stem and tributaries, respectively.
	2. Provide 1 year level of protection to Kankakee River.
	3. Allow planned development of flood-prone areas at a land use intensity compatible with state laws.
	4. Provide restricted use and development of flood-prone areas, thereby reducing risk of loss of life.
C. Recreational opportunities	1. Create 3,362,000 recreation visits for a mix of rural and urban population.

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estimating costs. All land rights costs assume purchase of land; however, lease arrangements should be given prime consideration when implementing any part of the flood control measures.

The remaining plan elements relating to accelerated land treatment, recreation, and flood plain management are discussed under Section IX-A (Plan Elements).

b. Environmental Quality Objective - Alternative E

Component needs identified with the EQ objective are in six (6) general categories:

1. Accelerated land treatment to reduce erosion and increase production efficiency on 683,300 acres of agricultural land.
2. Protection and management on about 140,000 acres of woodland habitat (primarily riparian type and small woodlots).
3. Protect about 10,000 acres of classified wetlands.
4. Protection and improvement of about 635 miles of fisheries and riparian wildlife habitat.
5. Management of flood prone areas on more than 222,000 acres.
6. Protection of about 14,000 acres of Kankakee River flood plain habitat (non-cropland).

Elements assigned to the EQ objective to help satisfy the identified component needs are:

1. Accelerate the land treatment program by installation of conservation measures to reduce erosion and adequately treat 426,400 acres.
2. Change about 25,300 acres of erosion and drought hazard cropland (Class IV, VI, and VII) to non-cropland for reduction of erosion and sedimentation and for adequate treatment of land within its capability. (In addition to the accelerated land treatment program).
3. Protect about 10,000 acres of classified wetland 1/ (Types 3, 4, 5, 6^3 and 6^4) and about 140,000 acres of existing woodland habitat.
4. Establish program for protection and maintenance of 220 miles of stream fisheries and wildlife habitat classified as fair to excellent.
5. Initiate active program of stream fisheries and riparian wildlife habitat improvement on 415 miles of stream.
6. Amend or adopt flood plain zoning ordinances, building codes, and similar regulations for all identified flood prone areas in the Basin and allow eligibility for flood insurance.

1/ "Wetlands of the United States", U.S. Department of Interior Fish and Wildlife Circular 39.

7. Purchase or lease about 14,000 acres of non-cropland areas in permanent vegetative cover along the Kankakee River between U. S. Route 30 and U.S. Route 41 in Indiana, and protect that area for its natural, scenic and aesthetic qualities.

These elements are summarized in Table IX-6 as Alternative E - Environmental quality.

The accelerated land treatment program planned specifically for environmental quality includes consideration of additional changes in land use from cropland to permanent cover on the more erosive soils. This conversion of about 25,200 acres of cropland is in addition to the 26,900 acres in the NED land treatment proposal, and would eliminate the need for part of the special erosion control measures such as stripcropping, terracing, and diversions included in the NED alternative on those converted acres. On-farm drainage needs are not included in satisfying the environmental quality objective. The exclusion of drainage and certain erosion control measures from the land treatment program will reduce the total estimated cost for the early action program from $14,123,600 for the NED objective to about $13,328,400 for the EQ objective. The accelerated land treatment program will improve the productive capacity of cropland through implementation of recommended tillage, vegetative, and management practices on individual farms.

The remaining plan elements relating to protection of wetlands and woodland habitat, protection and maintenance of stream fisheries and riparian wildlife habitat, flood plain management, and protection of 14,000 acres of Kankakee River non-cropland flood plain were previously discussed under Section IX-A (Plan Elements).

2. Additional Alternatives

In order to provide a mix of various opportunities for development, the elements identified for the NED and EQ objectives were either modified or duplicated in three additional alternatives. These are labeled Alternatives B, C, and D, implying that the NED and EQ alternatives represent the extremes of the spectrum. Each additional alternative is discussed below to the extent of listing elements and explaining differences from similar elements contained in either Alternative A or Alternative E. In addition Table IX-12 provides a summary comparison of each alternative and Tables IX-13 and IX-14 relate to the capability of each alternative to satisfy the identified needs.

TABLE IX - 6: ALTERNATIVE E - ENVIRONMENTAL QUALITY
NATIONAL ECONOMIC DEVELOPMENT ACCOUNT

Components	Measures of Effects 1/ (Average Annual) ($1,000)
Beneficial Effects:	
A. The value to users of increased outputs of goods and services	
1. Flood prevention	155.0
Total beneficial effects	155.0

Components	Measures of Effects (Average Annual) 2/ ($1,000)
Adverse Effects:	
A. The value of resources required for implementation of elements	
1. Fishery and wildlife habitat protection	
Installation	15.2
Land Rights	70.9
OM&R	63.5
2. Erosion control (land use adjustment)	
Installation	128.4
Land Rights	1,124.0
3. Classified wetlands protection	
Land Rights	100.0
Property tax loss	70.0
4. Floodplain management program	
Flood-prone area identification	49.1
Program administration	40.0
5. Protection of natural areas	
Land Rights	491.3
Total adverse effects	2,152.4
Net benefits	-1,997.4

1/ Accelerated land treatment program for erosion control and increased production efficiency not evaluated in monetary terms. Total installation cost estimated to be $13,328,400.

2/ Installation costs amortized for 100 years @ 6 1/8 percent interest. Includes program administration.

TABLE IX - 6 ALTERNATIVE E - ENVIRONMENTAL QUALITY

ENVIRONMENTAL QUALITY ACCOUNT

Components	Measures of Effects
Beneficial and adverse effects:	
A. Areas of natural beauty	1. Preserve 222,000 acres of floodplain for agricultural, natural or recreational uses. 2. Provide 400 acres of protected area for wildlife. 3. Protect and improve stream fisheries and riparian wildlife habitation on 635 miles of stream.
B. Quality considerations of water, land and air resources.	1. Decrease agricultural nutrient contribution to streams 2. Reduce the average annual gross erosion rate for the Basin from 1.2 tons/acre/year to 0.7 tons/acre/year. 3. Remove 25,300 acres from crop production. 4. Improve water quality by reducing erosion and sedimentation, and by increasing infiltration and reducing storm run-off.
C. Biological resources and selected ecosystems.	1. Temporary disruption of aquatic ecosystem on 415 miles of stream. 2. Continued maintenance on 635 miles of riparian wildlife habitat. 3. Improve wildlife cover on 22,000 acres for species favoring grass and 3,300 acres for species favoring forest environment. 4. Protect 10,000 acres of classified wetlands and 140,000 acres of woodland and related habitats. 5. Increase quantity and improve quality of wildlife habitat through land treatment program. 6. Temporary disruption of aesthetic quality and temporary increase in fire hazard from Timber Stand Improvement practices.
D. Irreversible or irretrievable commitments of resources.	1. Retain 10,000 acres of wetlands and 140,000 acres of woodland in its current use. 2. Retain 14,000 acres of floodplain in its present use.

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TABLE IX - 6(cont): ALTERNATIVE E - ENVIRONMENTAL QUALITY

REGIONAL DEVELOPMENT ACCOUNT

Components	Measures of Effects 1/ Region 2/ (Average Annual) ($1,000)	Rest of Nation
Income:		
Beneficial effects:		
A. The value of increased output of goods and services to users residing in the region		
1. Flood prevention	155.0	-
2. Erosion control (land use adjustment)	649.8	-649.8
3. Additional wages and salaries accruing to the region from implementation of the plan	150.9	-150.9
Total beneficial effect	955.7	-800.7

Components	Measures of Effects Region (Average Annual) ($1,000)	Rest of Nation 3/
Income:		
Adverse effects:		
A. The value of resources contributed from within the region to achieve the outputs		-
1. Fishery and wildlife habitat protection		
Installation	15.2	-
Land Rights	70.9	-
OM&R	63.5	-
2. Erosion control (land use adjustment)		
Installation	128.4	-
Land Rights	1,124.0	-
3. Classified wetlands protection		
Land Rights	100.0	-
Property tax loss	70.0	-
4. Floodplain management program		
Flood-prone area identification	-	49.1
Program administration	40.0	
5. Protection of Natural Areas		
Land Rights	491.3	
B. Losses in output resulting in external diseconomies, associated with alternate use of land	526.1	-526.1
Total adverse effects	2,629.4	-477.0
Net beneficial effects	-1,673.7	-323.7

1/ Accelerated land treatment program for erosion control and increased efficiency of production (exclusive of drainage) not evaluated in monetary terms. Total installation cost estimated to be $13,328,400.

2/ Includes Indiana Planning Regions 1, 2 and 4. See page III - 1 for counties involved.

3/ Installation costs amortized for 100 years @ 6 1/8 percent interest. Includes program administration.

TABLE IX - 6(cont): ALTERNATIVE E - ENVIRONMENTAL QUALITY

REGIONAL DEVELOPMENT ACCOUNT

Components	Measures of Effects: Region	Measures of Effects: Rest of Nation	Components	Measures of Effects: Region	Measures of Effects: Rest of Nation
Beneficial effects:			Adverse effects		
A. Increase in number and types of jobs.					
1. Land treatment installation	146 man-years skilled jobs				
	300 man-years semi-skilled jobs				
	300 man-years unskilled jobs				
2. Project Construction	39 man-years skilled jobs				
	4 man-years semi-skilled jobs				
	3 man-years unskilled jobs				
3. Project OM&R	3 permanent semi-skilled jobs				
	2 permanent skilled jobs				
Total beneficial effect	185 man-years skilled jobs				
	304 man-years semi-skilled jobs				
	303 man-years unskilled jobs				
	2 permanent skilled jobs				
	3 permanent semi-skilled jobs				

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TABLE IX - 6(cont): ALTERNATIVE E - ENVIRONMENTAL QUALITY

SOCIAL WELL-BEING ACCOUNT

Components	Measure of Effects
Beneficial and adverse effects:	
A. Real income distribution	1. Create 83 low to medium income and 2 higher income permanent jobs for region residents. 2. Create 792 man-years of jobs. 3. It is estimated that regional income of $955,700 and regional costs of $2,629,400 will accrue in about the same proportion as the following income class distribution:

Income Class (dollars)	Percentage of Adjusted Gross Income in Class
Less than 3,000	7
3,000 to 10,000	40
More than 10,000	53

b. Life, health and safety	1. Allow planned development of flood-prone areas at the land use intensity compatible with State law. 2. Provide restricted use and development of flood-prone areas, thereby reducing risk of loss of life.

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a. Alternative B

Elements identified with Alternative B are:

1. Channel work on 26 miles of the Kankakee River from Ind. Route 223 in St. Joseph County to U.S. Route 30 and wide levees (with no channel work) along Kankakee River from U.S. Route 30 to U. S. Route 41; for flood prevention and drainage.

2. Channel work on 13 selected tributaries of the Kankakee River in Indiana for flood prevention and drainage, as listed in the discussion of plan elements.

3. Accelerated land treatment program which includes installation of conservation measures to reduce erosion and adequately treat 426,400 acres.

4. Accelerated land treatment program which includes installation of on-farm resource management systems to adequately treat 247,500 acres of cropland for drainage.

5. About 4800 acres of county parks and 1500 acres of regional parks near or adjacent to existing water areas to satisfy a variety of recreational needs.

6. Riverside recreational development on about 900 acres along the Kankakee River in Lake County between U.S. Route 41 and the state line.

7. Provide public access for canoeing on the Kankakee River (43 miles - Ind. Route 8 to U. S. Route 41), Yellow River (41 miles - Plymouth to the Kankakee River), and Iroquois River (28 miles - Rensselaer to the state line), with public launching sites provided for each 10 miles of stream.

8. Develop about 70 miles of bridle trails on the Iroquois River (20 miles - western Jasper County to the state line) and Kankakee River (50 miles - U.S. Route 30 to U.S. Route 41).

9. Establish 74 miles of trails for bicycling, hiking and/or nature walks along the Kankakee River from U.S. Route 41 to the Potato Creek State Park.

10. Establish flood plain management program for all identified flood prone areas in the Basin, to include zoning ordinances, building codes or similar regulations, and allow eligibility for flood insurance.

These elements are summarized in Table IX-7 as Alternative B. The elements of Alternative B are, with the exception of the flood protection elements, similar to or scaled-down versions of

Alternate A elements. The flood protection elements differs from that of Alternative A in that channel work on the Kankakee River below U. S. Route 30 is replaced with wide-spaced levees to U. S. Route 41. No work is proposed downstream from U.S. Route 41.

Flood protection system 4A is contained in Alternative B and the proposal for the main stem consists of about 26 miles of channel work upstream from U. S. Route 30 and about 49 miles of wide-levees between U. S. Route 30 and U. S. Route 41. In addition, channel work is included for the 13 selected tributaries listed under the discussion of plan elements (IX-A).

Flood protection system 4A is presented as a system that would provide flood damage reduction and drainage benefits throughout most of the Kankakee River flood plain in Indiana, and limit induced flood stages downstream and in Illinois to a minimum. This system, as all others included in this report, would provide for a 1-year (2-year cropping season) level of protection. Higher levels of protection were originally considered but discarded because they resulted in substantial induced flood stages in Illinois.

The wide levees as envisioned in this system would be spaced about 1,000 feet apart near U. S. Route 30, and about 3,200 feet apart at U. S. Route 41. Between these locations the width would vary, increasing to 4,500 feet at one location. The exact location of the levees would be determined during a detailed implementation study which would be required prior to the installation of any alternative. However, as presented here, the levees would be situated to take advantage of the non-cropland areas along the river (See Figure IX-1). The distance between the levees need not be uniform and could be adjusted so that a minimum of existing cropland would be removed from production. The levee height would be in the range of 2 to 4 feet. "Spillway" sections would provide for protection of the levees and for storing part of larger flood volumes (greater than 1-year frequency) on the landward side of the levees.

About 14,000 acres of land, mostly non-cropland, would be included between the levees. Tie-back levees would be installed for the tributaries and pumps installed for interior drainage. Collection ditches would be required along the landward side of the levees. Tributary pumping costs are assigned to the wide levees for tributaries where they would not otherwise be necessary.

Figure IX-1. Sketch illustrating Kankakee River with levees proposed for agricultural protection under flood protection system measure 4A(Alternative B). Note that the widely spaced levees would incorporate primarily non-cropland areas.

TABLE IX - 7: ALTERNATIVE B

NATIONAL ECONOMIC DEVELOPMENT ACCOUNT

Components	Measures of Effects 1/ (Average Annual) ($1,000)
Beneficial Effects:	
A. The value to users of increased outputs of goods and services	
1. Flood prevention	1,328.2
2. Drainage	8,773.8
3. Recreation	2,421.4
Total beneficial effects	12,523.4

Components	Measures of Effects (Average Annual) 2/ ($1,000) NED	EQ
Adverse Effects:		
A. The value of resources required for implementation of elements		
1. Multipurpose channel work		
Installation	1,469.2	-
Land Rights	1,396.4	-
OM&R	263.5	-
2. On-farm drainage systems 3/		
Installation	2,580.6	-
OM&R	829.1	-
3. Recreation		
Installation	318.4	
Land Rights	388.4	
OM&R	388.6	
4. Floodplain management program		
Flood-prone area identification	49.1	
Program administration	40.0	
Total adverse effects	7,723.3	
Net beneficial effects	4,800.1	

1/ Accelerated land treatment program for erosion control and increased production efficiency not evaluated in monetary terms. Total installation cost estimated to be $14,123,600.

2/ Installation costs amortized for 100 years @ 6 1/8 percent interest. Includes program administration.

3/ Portion of Accelerated Land Treatment program.

ENVIRONMENTAL QUALITY ACCOUNT

Components	Measures of Effects
Beneficial and adverse effects:	
A. Areas of natural beauty	1. Preserve 222,000 acres of floodplain for agricultural, natural or recreational uses. 2. Provide 2,100 acres of protected area for wildlife. 3. Disrupt tranquility of rural environment by providing public access and recreation activities for 1,977,500 recreation visits.
B. Quality considerations of water, land and air resources.	1. Decrease agricultural nutrient contribution to streams. 2. Extend public access to 112 miles of stream for canoeing and fishing. 3. Change 7,230 acres from private to public ownership. 4. Reduce bank erosion on 261 miles of stream. 5. Adequately treat about 426,000 acres to reduce erosion and increase production efficiency of agricultural land. 6. Remove 3,100 acreas from crop production. 7. Improve water quality by reducing erosion and sedimentation, and by increasing infiltration and reducing storm run-off.
C. Biological resources and selected ecosystems.	1. Temporary disruption of aquatic ecosystem on 320 miles of stream. 2. Continued maintenance on 261 miles of riparian wildlife habitat. 3. Establish 922 acres of permanent wildlife cover. 4. Assure permanent easement on 16,523 acres of existing wildlife habitat. 5. Increase quantity and improve quality of wildlife habitat through land treatment program. 6. Temporary disruption of aesthetic quality and temporary increase in fire hazard from Timber Stand Improvement practices.
D. Irreversible or irretrievable commitments of resources.	1. Replace 450 acres of wildlife habitat with public recreation facilities. 2. Change 234 acres of riparian wildlife habitat to open channel or grass.

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TABLE IX - 7(cont): ALTERNATIVE B

REGIONAL DEVELOPMENT ACCOUNT

Components	Measures of Effects 1/ Region 2/	Rest of Nation
	(Average Annual) ($1,000)	
Income:		
Beneficial effects:		
A. The value of increased output of goods and services to users residing in the region.		
1. Flood prevention	1,328.2	-
2. Drainage	12,044.0	-3,270.2
3. Recreation	2,421.4	-
4. Additional wages and salaries accruing to the region from implementation of the plan	2,126.4	-2,126.4
B. Indirect and induced activities associated with increased net returns from flood prevention. and drainage.	2,854.8	-2,854.8
Total beneficial effect	20,774.8	-8,251.4

Components	Measures of Effects: Region NED	Region EQ	Rest of Nation NED	Rest of Nation EQ
	(Average Annual) 3/ ($1,000)			
Income:				
Adverse effects:				
A. The value of resources contributed from within the region to achieve the outputs.				
1. Multipurpose channel work				
Installation	367.3	-	1,101.9	-
Land Rights	1,396.4	-	-	-
OM&R	263.5	-	-	-
2. On-farm drainage system 4/				
Installation	2,580.6	-	-	-
OM&R	829.1	-	-	-
3. Recreation				
Installation	145.9	-	172.5	-
Land Rights	194.2	-	194.2	-
OM&R	388.6	-	-	-
4. Floodplain management program				
Flood-prone area identification	-	-	49.1	-
Program administration	40.0	-	-	-
B. Losses in output resulting in external diseconomies.				
1. Land rights for recreation	139.9	-	-139.9	-
Total adverse effects	6,345.5		1,377.8	
Net beneficial effects	14,429.3		-9,629.2	

1/ Accelerated land treatment program for erosion control and increased production efficiency (exclusive of drainage). not evaluated in monetary terms. Total installation cost estimated to be $14,123,600.
2/ Includes Indiana Planning Regions 1, 2 and 4.
3/ Installation costs amortized for 100 years @6 1/8 percent interest. Includes program administration.
4/ Portion of Accelerated Land Treatment program.

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TABLE IX - 7(cont): ALTERNATIVE B

REGIONAL DEVELOPMENT ACCOUNT

Components Employment Beneficial effects:	Measures of Effects Region	 Rest of Nation	Components Employment Adverse effects	Measures of Effects Region	 Rest of Nation
A. Increase in number and types of jobs					
1. Agricultural employment	238 man-years in agricultural production	-			
2. Land treatment installation 1/	452 man-years skilled jobs	-			
	1551 man-years semi-skilled jobs	-			
	582 man-years unskilled jobs	-			
3. Land treatment OM&R 1/	38 permanent semi-skilled jobs	-			
4. Recreation Service Sector	9 permanent seasonal semi-skilled jobs	-			
	9 permanent seasonal unskilled jobs	-			
5. Project construction	210 man-years skilled jobs	-			
	696 man-years semi-skilled jobs	-			
	175 man-years unskilled jobs	-			
6. Project OM&R	12 permanent semi-skilled jobs	-			
	2 permanent skilled jobs	-			
Total beneficial effect	662 man-years skilled jobs	-			
	2247 man-years semi-skilled jobs	-			
	757 man-years unskilled jobs	-			
	50 permanent semi-skilled jobs	-			
	9 permanent seasonal unskilled jobs	-			
	9 permanent seasonal semi-skilled jobs	-			
	2 permanent skilled jobs	-			

1/ Includes on-farm drainage systems.

TABLE IX - 7(cont): ALTERNATIVE B

SOCIAL WELL-BEING ACCOUNT

Components	Measures of Effects
Beneficial and adverse effects:	
A. Real income distribution	1. Create 50 low to medium income and 2 higher income permanent jobs for region residents.
	2. Create 18 low to medium income permanent seasonal jobs for region residents.
	3. Create 3,666 man-years of jobs.
	4. It is estimated that regional income of \$20,774,800 and regional costs of \$6,345,500 will accure in about the same porportion as the following income class distribution:

Income Class (dollars)	Percentage of Adjusted Gross Income in Class
Less than 3,000	7
3,000 to 10,000	40
More than 10,000	53

Components	Measures of Effects
B. Life, health and safety	1. Provide 60 percent and 45 percent flood damage reduction to Kankakee River Main Stem and tributaries, respectively.
	2. Provide 1-year level of protection to Kankakee River.
	3. Provide restricted use and development of flood-prone areas, thereby reducing risk of loss of life.
	4. Allow planned development of flood-prone areas at the land use intensity compatible with state law.
C. Recreational opportunities	1. Create 1,977,500 recreation visits for a mix of rural and urban population.
	2. Provide opportunity for region residents to enjoy the natural, scenic and aesthetic values of the streams.

Costs have been included for protection of existing housing developments, such as Sumava Resorts, that are located such that they would be between the wide levees. This protection could take the form of additional levees or "ring dikes" and in some cases, relocation. Interior drainage and pumps would also be required. All land rights costs assume purchase of land; however, lease arrangements should be given prime consideration when implementing any part of the flood control measures.

Table IX-2 indicates that this measure 4A would result in a 0.2 foot stage increase at Momence, Illinois for the 10-year and 100-year floods. A 0.6 foot and 0.9 foot stage increase is projected for the 2-year and 10-year floods, respectively. Induced damages resulting from these increased stages is included in the adverse effects (costs) as shown on Table IX-7. These induced costs include $648,000 for floodproofing of 216 dwellings located downstream from U. S. Route 41 and $32,500 for flowage easements including an additional 240 acres downstream from U.S. 41 flooded by the 100-year event due to the increased stage. This flow easement costs exceeds the calculated downstream induced damages to agriculture.

Costs have been included for stability of the stream banks and for on-site mitigation of fish and wildlife habitat losses on the 26 miles of channel work above U. S. Route 30 and on the channel work in the 13 selected tributaries. Special construction methods, such as one-side excavation, have been considered in estimating costs and in reducing wildlife habitat losses.

The accelerated land treatment program is similar to that of Alternative A except that only 75 percent of the on-farm drainage is included. The recreation elements are similar to those of Alternative A, but the areas provided for public parks represents only about 75 percent of the acreage included under Alternative A. Public access for canoeing and the riverside recreational development are similar to Alternative A. The mileage of bridle trails increased because of the availability of land between the levees as provided for under the flood control element, and the trails system represents about 35 percent of that included under Alternative A. The flood plain management element is identical to that of Alternative A.

b. Alternative C

Elements identified with Alternative C are:

1. Channel work on 26 miles of the Kankakee River from Ind. Route 223 in St. Joseph County to U. S. Route 30 in Starke and LaPorte Counties, for flood prevention and drainage.

2. Channel work on 13 selected tributaries of the Kankakee River in Indiana for flood prevention and drainage, as listed under Plan Elements (IX-A).

3. Accelerated land treatment program which includes installation of conservation measures to reduce erosion and adequately treat 426,400 acres.

4. Accelerated land treatment program which includes installation of on-farm drainage systems to adequately treat 165,000 acres of cropland for drainage.

5. About 3200 acres of county parks and 1000 acres of regional parks near or adjacent to existing water areas to satisfy a variety of recreational needs.

6. Riverside recreational development on about 450 acres along the Kankakee River in Lake County between U. S. Route 41 and the state line.

7. Provide public access for canoeing on portions of the Kankakee, Yellow, and Iroquois Rivers as described under Alternative A.

8. Develop about 20 miles of bridle trails along the Iroquois River as described under Alternative A.

9. Establish about 37 miles of trails for bicycling, hiking and/or nature walks from urban centers to natural areas and the Kankakee River.

10. Change about 12,650 acres of erosion and drought hazard cropland (Class IV, VI, and VII) to non-cropland for reduction of erosion and sedimentation and for adequate treatment of land within its capability. (In addition to the accelerated land treatment program).

11. Protect about 50,000 acres of existing woodland habitat.

12. Establish program for protection and maintenance of 22 miles of stream fisheries and riparian wildlife presently classified as fair to excellent.

13. Initiate an active program of stream fisheries and riparian wildlife habitat improvement on about 41 miles of stream.

14. Establish flood plain management program for all identified flood prone areas in the Basin including zoning ordinances, building codes or similar regulations and allow eligibility for flood insurance.

These elements are summarized in Table IX-8, Alternative C. The elements of Alternative C include scaled-down versions of most of those elements included in either Alternative A or Alternative E.

The flood protection system (No. 7) is similar to that of Alternative A for the 13 selected tributaries and the Main Stem of the Kankakee River above U. S. Route 30. No work is proposed for the Kankakee River below U. S. Route 30. The accelerated land treatment program is similar to Alternative A, except for the deletion of 50 percent of the on-farm drainage.

The recreation elements are similar to Alternative A in terms of activities provided for; however, the recreation areas are smaller in size. The acreage for public parks is about 50 percent of the area included for this purpose under Alternative A. The Riverside Recreation Development is also reduced in area by 50 percent. The trails system in this Alternative represents about 19 percent of the trails included under Alternate A. Public access for canoeing and bridle trails are identical to those of Alternative A. The flood plain management element is identical to Alternatives A, B, and D.

The changed land use element proposes a change of about 50 percent of the erosion and drought hazard cropland to non-cropland that is proposed under Alternative E. The protection of woodland habitat under this Alternative is about 36 percent of that proposed under Alternative E. The improvement, protection, and maintenance of stream fisheries and riparian wildlife habitat proposed represents about 10 percent of that proposed under Alternative E. The flood plain management element is similar to the other 4 Alternatives.

Table IX-2 indicates a 0.1 foot stage increase at Momence for the 1-year flood and a 0.2 foot increase for the 2-year, 10-year and 100-year floods. Consequent induced damages resulting from these stage increases is reflected in the adverse effects (costs) shown on Table IX-8. These induced costs include $1,400,000 for floodproofing 459 dwellings below U. S. Route 30 and into Illinois and $32,500 for flowage easements to cover the induced agricultural damages below U. S. Route 41 and into Illinois.

c. <u>Alternative D</u>

Elements identified with Alternative D are:

1. Channel work on 13 selected tributaries of the Kankakee River in Indiana, for flood control and drainage.

2. Accelerated land treatment program which includes installation of conservation measures to reduce erosion and adequately treat 426,000 acres.

TABLE IX - 8: ALTERNATIVE C

NATIONAL ECONOMIC DEVELOPMENT ACCOUNT

Components	Measures of Effects 1/ (Average Annual) ($1,000)
Beneficial Effects:	
A. The value to users of increased outputs of goods and services	
1. Flood prevention	957.4
2. Drainage	5,627.1
3. Recreation	1,507.8
Total beneficial effects	8,092.3

Components	Measures of Effects (Average Annual) 2/ ($1,000) NED	EQ
Adverse Effects:		
A. The value of resources required for implementation of elements		
1. Multipurpose channel work		
Installation	1,246.8	-
Land Rights	291.3	-
OM&R	162.3	-
2. On-farm drainage systems 3/		
Installation	1,720.4	-
OM&R	552.8	-
3. Fishery and wildlife habitat protection		
Installation	-	1.5
Land Rights	-	7.1
OM&R	-	6.4
4. Recreation		
Installation	211.2	-
Land Rights	287.0	-
OM&R	256.0	
5. Erosion control (land use adjustment)		
Installation	-	64.2
Land Rights	-	562.0
6. Woodland habitat protection		
Property tax loss	-	25.0
7. Floodplain management program		
Flood-prone area identification	49.1	-
Program administration	40.0	-
Total adverse effects	4,816.9	666.2
Net beneficial effects	3,275.4	-666.2

1/ Accelerated land treatment program for erosion control and increased production efficienty not evaluated in monetary terms. Total installation cost estimated to be $14,123,600.

2/ Installation costs amortized for 100 years @ 6 1/8 percent interest. Includes program administration.

3/ Portion of accelerated Land Treatment Program

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TABLE IX - 8(cont) - ALTERNATIVE C

ENVIRONMENTAL QUALITY ACCOUNT

Components	Measures of Effects
Beneficial and adverse effects: A. Areas of natural beauty	1. Preserve 222,000 acres of floodplain for agricultural, natural or recreational uses. 2. Provide 1,400 acres of protected area for wildlife. 3. Disrupt tranquility of rural environment by providing public access and recreation activities for 1,211,950 recreation visits. 4. Protect and improve stream fisheries and riparian wildlife habitation on 63 miles of stream.
B. Quality considerations of water, land and air resources.	1. Decrease agricultural nutrient contribution to streams. 2. Extend public access to 112 miles of stream for canoeing and fishing. 3. Change 4,650 acres from private to public ownership. 4. Reduce bank erosion on 261 miles of stream. 5. Adequately treat about 426,000 acres to reduce erosion and increase production efficiency of agricultural land. 6. Remove 2,100 acres from crop production. 7. Improve water quality by reducing erosion and sedimentation, and by increasing infiltration and reducing storm run-off.
C. Biological resources and selected ecosystems.	1. Temporary disruption of aquatic ecosystem on 320 miles of stream. 2. Continued maintenance on 261 miles of riparian wildlife habitat. 3. Improve wildlife cover on 11,000 acres for species favoring grass and 1,650 acres for species favoring forest environment. 4. Establish 742 acres of permanent wildlife cover. 5. Assure permanent easement on 488 acres of existing wildlife habitat. 6. Protect 50,000 acres of woodland and its related habitat. 7. Increase quantity and improve quality of wildlife habitat through land treatment program. 8. Temporary disruption of aesthetic quality and temporary increase in fire hazard from Timber Stand Improvement practices.
D. Irreversible or irretrievable commitments of resources.	1. Replace 315 acres of wildlife habitat with public recreation facilities. 2. Change 234 acres of riparian wildlife habitat to open channel or grass. 3. Protect 50,000 acres of woodland and restrict its use.

TABLE IX - 8(cont): ALTERNATIVE C

REGIONAL DEVELOPMENT ACCOUNT

Components	Measures of Effects 1/	
	Region 2/	Rest of Nation
	(Average Annual) ($1,000)	
Income:		
Beneficial effects:		
A. The value of increased output of goods and services to users residing in the region		
1. Flood prevention	957.4	-
2. Drainage	7,708.9	-2,081.8
3. Recreation	1,507.8	-
4. Erosion control (land use adjustment)	324.9	-324.9
5. Additional wages and salaries accruing to the region from implementation of the plan	1,550.1	-1,550.1
B. Indirect and induced activities associated with increased net returns from flood prevention, and drainage.	1,817.4	-1,817.4
Total beneficial effect	13,866.5	-5,774.2

Components	Measures of Effects			
	Region		Rest of Nation	
	NED	EQ	NED	EQ 3/
	(Average Annual) ($1,000)			
Income:				
Adverse effects:				
A. The value of resources contributed from within the region to achieve the outputs.				
1. Multipurpose channel work				
Installation	311.7	-	935.1	-
Land Rights	291.3	-	-	-
OM&R	162.3	-	-	-
2. On-farm drainage systems 4/				
Installation	1,720.4	-	-	-
OM&R	552.8	-	-	-
3. Fishery and wildlife habitat protection				
Installation	-	1.5	-	-
Land Rights	-	7.1	-	-
OM&R	-	6.4	-	-
4. Recreation				
Installation	96.8	-	114.4	-
Land Rights	143.5	-	143.5	-
OM&R	256.0	-	-	-
5. Erosion control (land use adjustment)				
Installation	-	64.2	-	-
Land Rights	-	562.0	-	-
6. Woodland habitat protection				
Property tax loss	-	25.0	-	-
7. Floodplain management program				
Flood-prone area identification	-	-	49.1	-
Program administration	40.0	-	-	-
B. Losses in output resulting in external diseconomies				
1. Alternate use of land	-	263.1	-	-263.1
2. Land rights for recreation	93.2	-	-93.2	-
Total adverse effects	3,668.0	929.3	1,148.9	-263.1
Net beneficial effects	10,198.5	-929.3	-6,923.1	263.1

1/ Accelerated land treatment program for erosion control and increased production efficiency (exclusive of drainage) not evaluated in monetary terms. Total installation cost estimated to be $14,123,600.
2/ Includes Indiana Planning Regions 1, 2 and 4.
3/ Installation costs amortized for 100 years @ 6 1/8 percent interest. Includes program administration.
4/ Portion of Accelerated Land Treatment Program

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TABLE IX - 8(cont): ALTERNATIVE C

REGIONAL DEVELOPMENT ACCOUNT

Components Employment Beneficial effects:	Measures of Effects Region	Rest of Nation	Components Employment Adverse effects:	Measure of Effects Region	Rest of Nation
A. Increase in number and types of jobs					
1. Agricultural employment	159 man-years in agricultural production	-			
2. Land treatment installation 1/	353 man-years skilled jobs	-			
	1140 man-years semi-skilled jobs	-			
	495 man-years unskilled jobs	-			
3. Land treatment OM&R 1/	25 permanent semi-skilled jobs	-			
4. Recreation Service Sector	6 permanent seasonal semi-skilled jobs	-			
	6 permanent seasonal unskilled jobs	-			
5. Project construction	177 man-years skilled jobs	-			
	567 man-years semi-skilled jobs	-			
	142 man-years unskilled jobs	-			
6. Project OM&R	9 permanent semi-skilled jobs	-			
	2 permanent skilled jobs	-			
Total beneficial effect	530 man-years skilled jobs	-			
	1707 man-years semi-skilled jobs	-			
	637 man-years unskilled jobs	-			
	34 permanent semi-skilled jobs	-			
	2 permanent skilled jobs	-			
	6 permanent seasonal semi-skilled jobs	-			
	6 permanent seasonal unskilled jobs	-			

1/ Includes on-farm drainage systems.

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TABLE IX - 8(cont): ALTERNATIVE C

SOCIAL WELL-BEING ACCOUNT

Components	Measures of Effects
Beneficial and adverse effects:	
A. Real income distribution	1. Create 34 low to medium income and 2 higher income permanent jobs for region residents.
	2. Create 12 low to medium income permanent seasonal jobs for region residents.
	3. Create 2,874 man-years of jobs.
	4. It is estimated that regional income of $13,866,500 and regional costs of $4,597,300 1/ will accrue in about the same proportion as the following income class distribution:

Income Class (dollars)	Percentage of Adjusted Gross Income in Class
Less than 3,000	7
3,000 to 10,000	40
More than 10,000	53

Components	Measures of Effects
B. Life, health and safety	1. Provide 30 percent and 45 percent flood damage reduction to the Kankakee River Main Stem and tributaries, respectively.
	2. Provide 1-year level of protection to Kankakee River above U.S. Route 30.
	3. Provide restricted use and development of flood-prone areas, thereby reducing risk of loss of life.
	4. Allow planned development of flood-prone areas at the land use intensity compatible with state law.
C. Recreational opportunities	1. Create 1,211,950 recreation visits for a mix of rural and urban population.
	2. Provide opportunity for region residents to enjoy the natural, scenic and aesthetic values of the streams.

1/ Includes environmental quality objective costs of $929,300.

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3. Accelerated land treatment program which includes installation of on-farm resource management systems to adequately treat 82,500 acres of cropland for drainage.

4. About 1600 acres of county parks and 500 acres of regional parks near or adjacent to existing water areas to satisfy a variety of recreational needs.

5. Riverside recreational development of about 450 acres along the Kankakee River in Lake County.

6. Provide public access for canoeing as described under Alternatives A, B, and C.

7. Develop about 20 miles of bridle trails along the Iroquois River.

8. Establish about 37 miles of trails for hiking, bicycling and/or nature walks from urban centers to natural areas and the Kankakee River.

9. Change about 12,650 acres of erosion and drought hazard cropland (Class IV, VI and VII) to non-cropland for reduction of erosion and sedimentation and for adequate treatment of land within its capability. (In addition to the land treatment program).

10. Protection of about 5,000 acres of existing classified wetlands.

11. Protection of about 100,000 acres of existing woodland habitat.

12. Establish program for protection and maintenance of 88 miles of stream fisheries and wildlife habitat classified as fair to excellent.

13. Initiate active program of stream fisheries and riparian wildlife habitat improvement on 166 miles of stream.

14. Amend or adopt flood plain zoning ordinances, building codes, and similar regulations for all identified flood prone areas in the Basin and allow eligibility for flood insurance.

These elements are summarized in Table IX-9 as Alternative D and represent a scaled down version of the elements of Alternative A plus those of Alternative E.

The flood protection system (No. 8) consists of channel work on 13 selected tributaries of the Kankakee River. No work is pro-

TABLE IX - 9: ALTERNATIVE D

NATIONAL ECONOMIC DEVELOPMENT ACCOUNT

Components	Measures of Effects 1/ (Average Annual) ($1,000)
Beneficial Effects:	
A. The value to users of increased outputs of goods and services	
1. Flood prevention	594.4
2. Drainage	3,336.5
3. Recreation	1,063.9
Total beneficial effects	4,994.8

Components	Measures of Effects (Average Annual) 2/ ($1,000) NED	EQ
Adverse Effects:		
A. The value of resources required for implementation of elements		
1. Multipurpose channel work		
Installation	938.6	-
Land Rights	201.5	-
OM&R	152.6	-
2. On-farm drainage systems 3/		
Installation	860.2	-
OM&R	276.4	-
3. Fishery and Wildlife habitat Protection		
Installation	-	6.1
Land Rights	-	28.4
OM&R	-	25.4
4. Recreation		
Installation	109.6	-
Land Rights	158.1	-
OM&R	152.4	-
5. Erosion control(land use adjustment)		
Installation	-	64.2
Land Rights	-	562.0
6. Classified wetlands protection		
Land Rights	-	50.0
Property tax loss	-	50.0
7. Floodplain management program		
Flood-prone area identification	49.1	-
Program administration	40.0	-
Total adverse effects	2,938.5	786.1
Net beneficial effects	2.056.3	-786.1

1/ Accelerated land treatment program for erosion control and increased production efficiency not evaluated in monetary terms. Total installation cost estimated to be $14,123,600

2/ Installation costs amortized for 100 years @ 6 1/8 percent interest. Includes program administration.

3/ Portion of Accelerated Land Treatment Program.

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TABLE IX - 9(cont): ALTERNATIVE D

ENVIRONMENTAL QUALITY ACCOUNT

Components	Measures of Effects
Beneficial and adverse effects:	
A. Areas of natural beauty	1. Preserve 222,000 acres of floodplain for agricultural, natural or recreational uses. 2. Provide 700 acres of protected area for wildlife. 3. Disrupt tranquility of rural environment by providing public access and recreation activities for 915,960 recreation visits. 4. Protect and improve stream fisheries and riparian wildlife habitation on 254 miles of stream.
B. Quality considerations of water, land and air resources.	1. Decrease agricultural nutrient contribution to streams. 2. Extend public access to 112 miles of stream for canoeing and fishing. 3. Change 2,550 acres from private to public ownership 4. Reduce bank erosion on 240 miles of stream. 5. Adequately treat about 426,000 acres to reduce erosion and increase production efficiency of agricultural land. 6. Remove 1,050 acres from crop production. 7. Improve water quality by reducing erosion and sedimentation, and by increasing infiltration and reducing storm run-off.
C. Biological resources and selected ecosystems.	1. Temporary disruption of aquatic ecosystem on 320 miles of stream. 2. Continued maintenance on 261 miles of riparian wildlife habitat. 3. Improve wildlife cover on 11,000 acres for species favoring grass and 1,650 acres for species favoring forest environment. 4. Establish 552 acres of permanent wildlife cover. 5. Assure permanent easement on 438 acres of existing wildlife habitat. 6. Protect 5,000 acres of classified wetlands and 100,000 acres of woodland and related habitat. 7. Increase quantity and improve quality of wildlife habitat through land treatment program. 8. Temporary disruption of aesthetic quality and temporary increase in fire hazard from Timber Stand improvement practices.
D. Irreversible or irretrievable commitments of resources.	1. Replace 315 acres of wildlife habitat with public recreation facilities. 2. Change 64 acres of riparian wildlife habitat to open channel or grass. 3. Restrict 105,000 acres of wetland and woodland to its present use.

TABLE IX -9 (cont): ALTERNATIVE D

REGIONAL DEVELOPMENT ACCOUNT

Components	Measures of Effects 1/ Region2/ (Average Annual) ($1,000)	Rest of Nation
Income:		
Beneficial effects:		
A. The value of increased output of goods and services to users residing in the region.		
1. Flood prevention	594.4	-
2. Drainage	4,566.5	-1,230.0
3. Recreation	1,063.9	-
4. Erosion control (land use adjustment)	324.9	-324.9
5. Additional wages and salaries accruing to the region from implementation of the plan	985.2	-985.2
B. Indirect and induced activities associated with increased net returns from flood prevention, and drainage.	1,073.8	-1,073.8
Total beneficial effect	8,608.7	-3,613.9

Components	Measures of Effects: Region NED	Region EQ (Average Annual) 3/ ($1,000)	Rest of Nation NED	Rest of Nation EQ
Income:				
Adverse effects:				
A. The value of resources contributed from within the region to achieve the outputs.				
1. Multipurpose channel work				
Installation	234.6	-	704.0	-
Land Rights	201.5	-	-	-
OM&R	152.6	-	-	-
2. On-farm drainage systems 4/				
Installation	860.2	-	-	-
OM&R	276.4	-	-	-
3. Fishery and wildlife habitat protection				
Installation	-	6.1	-	-
Land Rights	-	28.4	-	-
OM&R	-	25.4	-	-
4. Recreation				
Installation	50.2	-	59.4	-
Land Rights	79.1	-	79.0	-
OM&R	152.4	-	-	-
5. Erosion control (land use adjustment)				
Installation	-	64.2		
Land Rights	-	562.0	-	-
6. Classified wetlands protection				
Land Rights	-	50.0	-	-
Property tax loss	-	50.0	-	-
7. Floodplain management program				
Flood-prone area identification	-	-	49.1	-
Program administration	40.0	-	-	-
B. Losses in output resulting in external diseconomies				
1. Alternate use of land	-	263.1	-	-263.1
Land rights for recreation	46.6	-	-46.6	
Total adverse effects	2,093.6	1,049.2	844.9	-263.1
Net beneficial effects	6,515.1	-1,049.2	-4,458.8	263.1

1/ Accelerated land treatment program for erosion control and increased efficiency of production exclusive of drainage not evaluated in monetary terms.
Total installation cost estimated to be $14,123,600.
2/ Includes Indiana Planning Regions 1, 2 and 4.
3/ Installation costs amortized for 100 years @ 6 1/8 percent interest.
4/ Portion of Accelerated Land Treatment Program.

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TABLE IX - 9 (cont): ALTERNATIVE D

REGIONAL DEVELOPMENT ACCOUNT

Components	Measures of Effects		Components	Measures of Effects	
Employment Beneficial effects:	Region	Rest of Nation	Employment Adverse effects:	Region	Rest of Nation
A. Increase in number and types of jobs					
1. Agricultural employment	90 man-years in agricultural production	-			
2. Land treatment installations 1/	245 man-years skilled jobs	-			
	710 man-years semi-skilled jobs	-			
	387 man-years unskilled jobs	-			
3. Land treatment OM&R 1/	13 permanent semi-skilled jobs	-			
4. Recreation Service Sector	3 permanent seasonal semi-skilled jobs	-			
	4 permanent seasonal unskilled jobs	-			
5. Project construction	143 man-years skilled jobs	-			
	397 man-years semi-skilled jobs	-			
	109 man-years unskilled jobs	-			
6. Project OM&R	8 permanent semi-skilled jobs	-			
	2 permanent skilled jobs	-			
Total beneficial effect	388 man-years skilled jobs	-			
	1107 man-years semi-skilled jobs	-			
	496 man-years unskilled jobs	-			
	21 permanent semi-skilled jobs	-			
	2 man-years skilled jobs	-			
	3 man-years semi-skilled jobs	-			
	4 man-years unskilled jobs	-			

1/ Includes on-farm drainage systems.

TABLE IX - 9 (cont): ALTERNATIVE D

SOCICAL WELL-BEING ACCOUNT

Components	Measure of Effects
Beneficial and adverse effects:	
A. Real income distribution	1. Create 21 low to medium income permanent and 2 higher income jobs for region residents.
	2. Create 7 low to medium income permanent seasonal jobs for region residents.
	3. Create 1,991 man-years of jobs.
	4. It is estimated that regional income of $8,608,700 and regional costs of $3,142,800 1/ will accrue in about the same proportion as the following income class distribution:

Income Class (dollars)	Percentage of Adjusted Gross Income in Class
Less than 3,000	7
3,000 to 10,000	40
More than 10,000	53

1/ Includes environmental quality objective costs of $1,049,200.

Components	Measure of Effects
B. Life, health and safety	1. Provide 45 percent flood damage reduction to selected Kankakee River Basin tributaries.
	2. Provide restricted use and development of flood-prone areas, thereby reducing risk of loss of life.
	3. Allow planned development of flood-prone areas at the land use intensity compatible with State law.
C. Recreational opportunities	1. Create 915,960 recreation visits for a mix of rural and urban population.
	2. Provide opportunity for region residents to enjoy the natural, scenic and aesthetic values of the streams.

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posed for the Main Stem of the Kankakee River. The land treatment element is similar to that of Alternative A, B, C, and E except on-farm drainage is proposed for relatively small acreage (85,500 acres). Recreation elements provide for activities as in Alternative A but with a much reduced area for public parks and a minimum of hiking trails. Public access for canoeing and development of bridle trails is similar to Alternative A.

The changed land use element of 12,650 acres is similar to that in Alternative C and represents about 50 percent of that proposed for Alternative E. The protection of classified wetlands is 50 percent of the 10,000 acres proposed in Alternative E, and the protection of woodland habitat is about 70 percent of the 140,000 acres proposed under Alternative E. The improvement and protection of stream fisheries and wildlife habitat is about 40 percent of that proposed under Alternative E. The flood plain management element is identified to that of Alternatives A, B, C, and D.

Table IX-2 indicates that increased stages due to the proposed works of improvement on the 13 tributaries would increase stages from 0.1 to 0.2 foot. Induced damages from such stage increases are included in the adverse effects (costs) shown on Table IX-9. These costs include $648,000 for floodproofing 216 dwellings below U. S. Route 41 and $32,500 for flowage easement to cover the induced agricultural damages below U.S. 41.

C. Summary of Alternatives and Suggested Plan

1. Summary of Alternatives

As stated previously, Alternative B, C, and D are intended to provide a mix of the various elements proposed in the NED and EQ Alternatives (A&E, respectively). This mix of elements as illustrated in B, C, and D provides an indication of the numerous alternatives that can be formulated to provide for a coordinated, comprehensive plan of development for the water and related land resources of the Basin. The elements relating to flood plain management and accelerated land treatment for erosion control are the only elements duplicated in Alternatives A through E. All other elements in Alternatives B, C, and D represent different levels of development to satisfy the identified component needs. The elements within each of the three Alternatives (B, C, and D) are compatible with each other and can be installed as programs and/or resources become available. Any one element can be implemented at any time without jeopardizing the feasibility of other elements.

In order to provide the reader with additional information to judge the relative merits of the Alternatives presented, a summary comparison of Alternatives A thru E is provided in

Table IX-12. The capability of each Alternative to satisfy identified component needs is presented in Table IX-13 and graphically exhibited in Table IX-14.

2. Suggested Plan

Alternatives A through E were presented to the Citizen's Advisory Group and to the study paricipants via a preliminary draft report distributed in October of 1975. A public meeting was held in Valparaiso, Indiana on December 19, 1975 to further discuss these Alternatives. Following a 60-day review period, The Plan Formulation Subcommittee reviewed the comments received.

Consensus was not reached by the entire study group (federal, state and local agencies, and Citizen's Advisory Group) on those actions which should be recommended. The majority of comments received from Indiana residents supported flood control measure 2 and the land treatment element, but indicated little support for the recreation and environmental elements. Illinois residents indicated strong opposition to any channel work on the portion of the Kankakee River in their State. They are also opposed to any flood control project that would result in increased flooding in Illinois.

The Plan Formulation Subcommittee recognized that the degree of flood protection desired by the agricultural interests cannot be obtained due to the necessity for channel work (including rock excavation) in Illinois, and objection by the State of Illinois to such proposed action. Furthermore, it is recognized that channel widening and deepening of such extent would result in severe adverse effects to fish and wildlife habitat. However, it was determined that the study should present some viable combination of plan elements that would approach a solution to the problems in the Basin. Thus, the following combination of plan elements was selected to constitute this "Suggested Plan":

1. Channel work on 26 miles of the Kankakee River from Ind. Route 223 in St. Joseph County to U. S. Route 30, and 49 miles of wide levees (with no channel work) along the Kankakee River from U.S. Route 30 to U.S. Route 41, for flood prevention and drainage (See Plate 18).

2. Channel work on 13 selected tributaries of the Kankakee River in Indiana for flood prevention and drainage, as listed below:

Name	Miles
Bailey Ditch	26.9
Barnard(Hodge) Ditch	37.8
Benkie Ditch	4.9
Breyfogel Ditch	6.6
Crooked Creek	13.5
Dehaan Ditch	10.5
Hanna Arm	20.6
Phillips-Cornel Ditch	2.6
Robbins Ditch	40.0
Sandy Hook Ditch	18.7
Singleton Ditch	56.4
Cook Ditch	12.2
Marquardt Ditch	7.8

3. Accelerated land treatment program which includes installation of conservation measures to reduce erosion and adequately treat 426,400 acres.

4. Accelerated land treatment program which includes installation of on-farm resource management systems to adequately treat 247,500 acres of cropland for drainage.

5. About 2700 acres of county parks and 1500 acres of regional parks near or adjacent to existing water areas to satisfy a variety of recreational needs.

6. Riverside recreational development on about 450 acres along the Kankakee River in Lake County between U. S. Route 41 and the state line.

7. Provide public access for canoeing on the Kankakee River (43 miles - Ind. Route 8 to U. S. Route 41), Yellow River (41 miles - Plymouth to the Kankakee River), and Iroquois River (28 miles - Rensselaer to the state line), with public launching sites provided for each 10 miles of stream.

8. Develop about 20 miles of bridle trails along the Iroquois River from western Jasper County to the state line.

9. Establish about 37 miles of trails for bicycling, hiking and/or nature walks from urban centers to natural areas and the Kankakee River.

10. Change about 12,650 acres of erosion and drought hazard cropland (Class IV, VI and VII) to non-cropland for reduction of erosion and sedimentation, and for adequate treatment of land within its capability. (In addition to the land treatment program).

11. Protection of about 5,000 acres of existing classified wetlands.

12. Protection and management of about 100,000 acres of woodland habitat.

13. Establish program for protection and maintenance of 88 miles of stream fisheries and wildlife habitat classified as fair to excellent.

14. Initiate active program of stream fisheries and riparian wildlife habitat improvement on 166 miles of stream.

15. Amend or adopt flood plain zoning ordinances, building codes, and similar regulations for all identified flood prone areas in the Basin, and allow eligibility for flood insurance.

    The Plan elements are summarized in Table IX-10 and in Table IX-11 as the "Suggested Plan".

The choice of flood protection system 4A for the "Suggested Plan" represents a compromise. Flood protection system 2, which includes channel work downstream to Momence, Illinois, (including some rock excavation in the channel at Momence) although the most efficient in hydraulic and economic terms, is not considered a viable alternate due to the strong opposition from Illinois residents and because of severe environmental consequences of such action.

Flood protection system 4A is considered more practicable in that it does not involve actual work in Illinois, and it provides for a minimum of increase in flood stages downstream and into Illinois. At the same time, it is the only other system that provides flood damage reduction and drainage benefits throughout most of the Kankakee River flood plain in Indiana. The selection of flood protection system 4A represents a decision by the study group to include a viable system that would provide the greatest amount of benefits to the greatest number of Indiana citizens affected by the flooding and impaired drainage problem in the Kankakee River Basin. The concept of upstream channel work and wide levees downstream as now envisioned for system 4A would accomplish that objective. It should be remembered that this combination of channel work and levees is not a fixed proposal. Detailed engineering studies would be required as part of an implementation report prior to installation of any such measures. Alternate design concepts that might be developed from more refined engineering studies, provided they accomplished the same objectives, could be considered as a replacement to the wide levee-channel work concept and would be compatible with the "Suggested Plan".

The wide-spaced levees as envisioned in the Suggested Plan would be spaced about 1,000 feet apart near U. S. Route 30, and about 3,200 feet apart at U. S. Route 41. The exact location of the levees would be determined during a detailed implementation study which would be required prior to the installation of any alternative. However, as presented here, the levees would be situated to take advantage of the non-cropland areas along the River (See Figure IX-1). The distance between the levees need not be uniform and could be adjusted so that a minimum of existing cropland would be removed from production. The levee height would be typically 2 to 4 feet. "Spillway" sections in the levee would provide for protection of the levees and for storing part of the flood water on the landward side of the levees for flows exceeding the 1-year event.

About 14,000 acres of land, mostly non-cropland, would be included between the levees. Tie-back levees would be installed for the tributaries and pumps installed for interior drainage. Collection ditches would be required along the landward side of the levees. Tributary pumping costs are assigned to the wide levees for tributaries where they would not otherwise be necessary.

Appropriate costs have been included for protection of existing housing developments such as Sumava Resorts, that are located such that they would be between the wide levees. This protection could take the form of additional levees or "ring dikes" and, in some cases, relocation. Interior drainage and pumps would also be required. All land rights costs assume purchase of land; however, lease arrangements should be given prime consideration when implementing any part of the flood control measures.

Table IX-2 indicates that this measure 4A would result in a 0.2 foot stage increase at Momence, Illinois for the 10-year and 100-year floods. A 0.6 foot and 0.9 foot stage increase is projected for the 2-year and 1-year floods, respectively. Induced damages resulting from these increased stages is included in the adverse effects (costs) as shown on Table IX-7. These induced costs include $648,000 for floodproofing to protect from the 100 yr flood, the 216 dwellings located downstream from U. S. Route 41 and $32,500 for flowage easements including an additional 240 acres downstream from U. S. Route 41 that would be flooded in the 100-year event due to the increased stage. This flowage easement cost exceeds the calculated downstream induced damages to agriculture.

It is anticipated that the upstream channel work and downstream levees would be implemented concurrently. Should the channel work be implemented prior to the levees, further induced damages could result.

TABLE IX-10A COMPARISON OF PLAN ELEMENTS - SUGGESTED PLAN AND ALTERNATIVES A THROUGH E 1/
Kankakee River Basin, Indiana

Elements	A (NED)	B	C	D	E (EQ)
FLOOD PROTECTION CHANNEL WORK AND/OR LEVEES					
Kankakee River	82 miles channel work (Rt. 223 to Momence, Ill.)	26 miles channel work (Rt. 223 to Rt. 30) 49 miles wide levees (Rt. 30 to Rt. 41)	26 miles channel work (Rt. 223 to Rt. 30)	-----	-----
Tributaries	258.5 miles channel work	258.5 miles channel work	258.5 miles channel work	258.5 miles channel work	-----
ACC. LAND TREATMENT Erosion Control and Increased Production Efficiency (Acres)	426,400	426,400	426,400	426,400	426,400
On-Farm Drainage (Ac.)	330,000	247,500	165,000	82,500	-----
RECREATION					
County Parks (Ac.)	6,400	4,800	3,200	1,600	-----
Regional Parks (Ac.)	2,000	1,500	1,000	500	-----
Riverside Development (Ac.)	900	900	450	450	-----
Canoeing (Miles)	112	112	112	112	-----
Hiking - Bicycling Trails (Mi.)	198	74	37	37	-----
Bridle Trails (Mi.)	20	70	20	20	-----
PROTECTION OF CLASSIFIED WETLANDS (Acres)	-----	-----	-----	5,000	10,000
PROTECTION OF WOODLAND HABITAT (Acres)	-----	-----	50,000	100,000	140,000
CHANGE LAND USE for erosion control and land treatment (Ac.)	-----	-----	12,650	12,650	25,300
FISH & WILDLIFE HABITAT PROTECTION (Miles)	-----	-----	63	254	635
FLOOD PLAIN MANAGEMENT Ordinances, etc. (Ac.)	222,000	222,000	222,000	222,000	222,000
FLOOD PLAIN NATURAL AREA PRESERVATION (Ac.)	-----	-----	-----	-----	14,000

1/ ☐ Plan elements included in "Suggested Plan".

TABLE IX-10B COMPARISON OF INSTALLATION COSTS

Kankakee River Basin, Indiana
($1,000)

Elements	Alternatives A (NED)	B	C	D	E (EQ)	Suggested Plan
FLOOD PROTECTION CHANNEL WORK AND/OR LEVEES						
Kankakee River	28,659	30,215	6,481	-----	-----	30,215
Tributaries	16,881	16,447	18,565	18,565	-----	16,447
ACC. LAND TREATMENT Erosion Control and Increased Production Efficiency	14,124	14,124	14,124	14,124	13,328	14,124
On-Farm Drainage	56,300	42,022	28,015	14,007	-----	42,022
RECREATION	16,269	11,510	8,113	4,359	-----	8,113
County Parks					-----	
Regional Parks					-----	
Riverside Development					-----	
Canoeing					-----	
Hiking - Bicycling Trails					-----	
Bridle Trails					-----	
PROTECTION OF CLASSIFIED WETLANDS	-----	-----	-----	814	1,628	814
PROTECTION OF WOODLAND HABITAT	-----	-----	407	814	1,140	814
CHANGE LAND USE for erosion control and land treatment	-----	-----	10,197	10,197	20,394	10,197
FISH AND WILDLIFE HABITAT PROTECTION	-----	-----	140	562	1,402	562
FLOOD PLAIN MANAGEMENT Ordinances, etc.	1,451	1,451	1,451	1,451	1,451	1,451
FLOOD PLAIN NATURAL AREA PRESERVATION	-----	-----	-----	-----	8,000	-----
TOTAL	133,684	115,769	87,493	64,893	47,343	124,759

The accelerated land treatment program of Alternative B is included in this plan. It provides for about 75 percent of the on-farm drainage included in Alternative A.

The recreation elements contained in the "Suggested Plan" are similar to those of Alternative C. The only exception is that the regional park is increased to 1500 acres in order to comply with minimum desirable standards. To compensate for this increase, the total county park acreage is reduced from 3200 acres to 2700 acres. The 37 miles of trails is intended to include trails between some of the natural areas and the Kankakee River or between the natural areas and the larger communities. The final locations would be determined by local sponsors and could be drawn from any of the areas suggested under discussion of this item in Section IX-A (Plan Elements).

The environmental quality related plan elements are identical to those described under Alternative D. These elements are considered compatible with the NED related elements.

This "Suggested Plan" was formulated to represent that combination of actions or recommendations for development, any one of which can be supported by some of the study participants. All elements in the "Suggested Plan", which is summarized in Table IX-11. Recommendations for Development, are consistant with state and federal planning policies and procedures.

All elements need not be implemented immediately. The plan recognizes those elements which are compatible with each other and which can be installed as programs and/or resources become available. Any one element can be implemented at any time without jeopardizing the feasibility or practicality of other elements.

In order to provide additional information in which to judge the relative merits of the alternatives studies, a summary comparison of Alternates A through E is provided on Table IX-12. The capability of alternatives to satisfy identified component needs is presented in Tables IX-13 and IX-14. In each table, the plan elements for the "Suggested Plan" are indicated, enabling the reader to relate that plan to the 5 alternatives.

D. Environmental Assessment

Tables IX-5, IX-6, IX-7, IX-8, IX-9, and IX-11 summarize the effects of each set of Alternatives and the "Suggested Plan" in economic, physical, and social terms and Tables IX-12 and IX-13 provides comparisons between Alternative and the "Suggested Plan". The summaries under the various accounts provide the aggregate effects in physical and monetary terms. The effects noted in the environmental quality and social well-being accounts provide concise, objective environmental assessments of each Alternative and the "Suggested Plan".

TABLE IX - 11: SUGGESTED ALTERNATIVE

NATIONAL ECONOMIC DEVELOPMENT ACCOUNT

Components	Measures of Effects 1/ (Average Annual) ($1,000)
Beneficial Effects:	
A. The value to users of increased outputs of goods and services	
1. Flood prevention	1,328.2
2. Drainage	8,773.8
3. Recreation	1,507.8
Total beneficial effects	11,609.8

Components	Measures of Effects (Average Annual) 2/ ($1,000) NED	EQ
Adverse Effects:		
A. The value of resources required for implementation of elements		
1. Multipurpose channel work		
Installation	1,469.2	-
Land Rights	1,396.4	-
OM&R	263.5	-
2. On-farm drainage systems 3/		
Installation	2,580.6	-
OM&R	829.1	-
3. Fishery and wildlife habitat		
Installation	-	6.1
Land Rights	-	28.4
OM&R	-	25.4
4. Recreation		
Installation	211.2	-
Land Rights	287.0	-
OM&R	256.0	-
5. Erosion control (land use adjustment)		
Installation	-	64.2
Land Rights	-	562.0
6. Classified wetlands and woodland habitat protection		
Land Rights	-	50.0
Property tax loss	-	50.0
7. Floodplain management program		
Flood-prone area identification	49.1	-
Program administration	40.0	-
Total adverse effects	7,382.1	786.1
Net beneficial effects	4,227.7	-786.1

1/ Accelerated land treatment program for erosion control and increased production efficiency not evaluated in monetary terms. Total installation cost estimated to be $14,123,600.

2/ Installation costs amortized for 100 years @ 6 1/8 percent interest. Includes program administration.

3/ Portion of Accelerated Land Treatment Program.

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Sheet 1 of 5

TABLE IX - 11 (cont): SUGGESTED ALTERNATIVE

ENVIRONMENTAL QUALITY ACCOUNT

Components	Measures of Effects
Beneficial and adverse effects: A. Areas of natural beauty	1. Preserve 222,000 acres of floodplain for agricultural, natural or recreational uses. 2. Provide 1,400 acres of protected area for wildlife. 3. Disrupt tranquility of rural environment by providing public access and recreation activities for 1,211,950 recreation visits. 4. Protect and improve stream fisheries and riparian wildlife habitation on 254 miles of stream.
B. Quality considerations of water, land and air resources.	1. Decrease agricultural nutrient contribution to streams. 2. Extend public access to 112 miles of stream for canoeing and fishing. 3. Change 4,650 acres from private to public ownership. 4. Reduce bank erosion on 261 miles of stream. 5. Adequately treat about 426,000 acres to reduce erosion and increase production efficiency of agricultural land. 6. Remove 2,100 acres from crop production. 7. Improve water quality by reducing erosion and sedimentation, and by increasing infiltration and reducing storm run-off.
C. Biological resources and selected ecosystems.	1. Temporary disruption of aquatic ecosystem on 320 miles of stream. 2. Continued maintenance on 264 miles of riparian wildlife habitat. 3. Improve wildlife cover on 11,000 acres for species favoring grass and 1,650 acres for species favoring forest environment. 4. Establish 922 acres of permanent wildlife cover. 5. Assure permanent easement on 16,523 acres of existing wildlife habitat. 6. Protect 5,000 acres of classified wetland and its related habitat. 7. Increase quantity and improve quality of wildlife habitat through land treatment program. 8. Temporary disruption of aesthetic quality and temporary increase in fire hazard from Timber Stand Improvement practices.
D. Irreversible or irretrievable commitments of resources.	1. Replace 315 acres of wildlife habitat with public recreation facilities. 2. Change 234 acres of riparian wildlife habitat to open channel or grass. 3. Restrict 105,000 acres of wetlands and woodlands to its present use.

TABLE IX - 11 (cont): SUGGESTED ALTERNATIVE

REGIONAL DEVELOPMENT ACCOUNT

Components	Measures of Effects 1/ Region 2/	Rest of Nation
	(Average Annual) ($1,000)	
Income:		
Beneficial effects:		
A. The value of increased output of goods and services to users residing in the region		
1. Flood prevention	1,328.2	-
2. Drainage	12,044.0	-3,270.2
3. Recreation	1,507.8	-
4. Erosion control (land use adjustment)	324.9	-324.9
5. Additional wages and salaries accruing to the region from implementation of the plan	2,074.6	-2,074.6
B. Indirect and induced activities associated with increased net returns from flood prevention and drainage.	2,854.8	-2,854.8
Total beneficial effect	20,134.3	-8,524.5

Components	Measures of Effects: Region NED	Region EQ	Rest of Nation NED	Rest of Nation EQ
	(Average Annual) 3/ ($1,000)			
Income:				
Adverse effects:				
A. The value of resources contributed from within the region to achieve the outputs.				
1. Multipurpose channel work				
Installation	367.3	-	1,101.9	-
Land Rights	1,396.4	-	-	-
OM&R	263.5	-	-	-
2. On-farm drainage systems 4/				
Installation	2,580.6	-	-	-
OM&R	829.1	-	-	-
3. Fishery and wildlife habitat protection				
Installation	-	6.1	-	-
Land Rights	-	28.4	-	-
OM&R	-	25.4	-	-
4. Recreation				
Installation	96.8	-	114.4	-
Land Rights	143.5	-	143.5	-
OM&R	256.0	-	-	-
5. Erosion control (land use adjustment)				
Installation	-	64.2	-	-
Land Rights	-	562.0	-	-
6. Classified wetlands and woodland habitat protection				
Land Rights	-	50.0	-	-
Property tax loss	-	50.0	-	-
7. Floodplain management program				
Flood-prone area identification	-	-	49.1	-
Program administration	40.0	-	-	-
B. Losses in output resulting in external diseconomies				
1. Alternate use of land	-	263.1	-	-263.1
2. Land rights for recreation	93.2	-	-93.2	-
Total adverse effects	6,066.4	1,049.2	1,315.7	-263.1
Net beneficial effects	14,067.9	-1,049.2	-9,840.2	263.1

1/ Accelerated land treatment program for erosion control and increased production efficiency (exclusive of drainage) not evaluated in monetary terms.
Total installation cost estimated to be $14,123,600.

2/ Includes Indiana Planning Regions 1, 2 and 4.

3/ Installation costs amortized for 100 years @ 6 1/8 percent interest. Includes program administration.

4/ Portion of Accelerated Land Treatment Program.

TABLE IX - 11(cont): SUGGESTED ALTERNATIVE

REGIONAL DEVELOPMENT ACCOUNT

Components	Measures of Effects: Region	Measures of Effects: Rest of Nation	Components	Measure of Effects: Region	Measure of Effects: Rest of Nation
Employment Beneficial effects:			Employment Adverse effects:		
A. Increase in number and types of jobs.					
1. Agricultural employment	238 man-years in Agriculture Production	-			
2. Land treatment installation 1/	460 man-years skilled jobs 1571 man-years semi-skilled jobs 478 man-years unskilled jobs	- - -			
3. Land treatment OM&R 1/	38 permanent semi-skilled jobs	-			
4. Recreation Service Sector	3 permanent seasonal semi-skilled jobs 4 permanent seasonal unskilled jobs	- -			
5. Project construction	198 man-years skilled jobs 657 man-years semi-skilled jobs 164 man-years unskilled jobs	- - -			
6. Project OM&R	13 permanent semi-skilled jobs 2 permanent skilled jobs	- -			
Total beneficial effect	658 man-years skilled jobs 2228 man-years semi-skilled jobs 636 man-years unskilled jobs 51 permanent semi-skilled jobs 2 permanent skilled jobs 3 permanent seasonal semi-skilled jobs 4 permanent seasonal unskilled jobs	- - - - - - -			

1/ Includes on-farm drainage systems.

TABLE IX - 11(cont): SUGGESTED ALTERNATIVE

SOCIAL WELL-BEING ACCOUNT

Components	Measures of Effects
Beneficial and adverse effects:	
A. Real income distribution	1. Create 51 low to medium income and 2 higher income permanent jobs for region residents
	2. Create 7 low to medium income permanent seasonal jobs for region residents.
	3. Create 3,522 man-years of jobs.
	4. It is estimated that regional income of $20,134,300 and regional costs of $7,115,600 1/ will accrue in about the same proportion as the following income class distribution:

Income Class (dollars)	Percentage of Adjusted Gross Income in Class
Less than 3,000	7
3,000 to 10,000	40
More than 10,000	53

1/ Includes environmental quality objective costs of $1,049,200.

Components	Measures of Effects
B. Life, health and safety	1. Provide 60 percent and 45 percent flood damage reduction to the Kankakee River Main Stem and tributaries, respectively.
	2. Provide 1-year level of protection to Kankakee River above U.S. Route 30.
	3. Provide restricted use and development of flood-prone areas, thereby reducing risk of loss of life.
	4. Allow planned development of flood-prone areas at the land use intensity compatible with State law.
C. Recreational opportunities	1. Create 1,211,950 recreation visits for a mix of rural and urban population.
	2. Provide opportunity for region residents to enjoy the natural, scenic and aesthetic values of the streams.

TABLE IX -12: SUMMARY COMPARISON OF ALTERNATIVES
Kankakee River Basin, Indiana

Accounts	Alternative A National Economic Development	Alternative B	Alternative C	Alternative D	Alternative E (Environmental Quality)	Suggested Alternative
A. National Economic Development						
Beneficial Effects ($) 1/	16,192,900	12,523,400	8,092,300	4,994,800	155,000	11,609.8
Adverse Effects ($)	9,094,600	7,723,300	5,483,100	3,724,600	2,152,400	8,168.2
Net Beneficial Effects ($)	7,098,300	4,800,100	2,609,200	1,270,200	-1,997,400	3,441.6
B. Environmental Quality						
Beneficial and Adverse Effects						
1. Areas of Natural Beauty						
a. Protect areas for wildlife, natural, agricultural or recreational uses (acres)	224,800	224,100	223,400	222,700	222,000	223,400
b. Protect and improve stream fisheries and riparian wildlife habitat.	-	-	63 miles	254 miles	635 miles	254 miles
2. Quality Consideration of Water, Land and Air Resources.						
a. Reduce streambank erosion	320 miles	261 miles	261 miles	240 miles	-	261 miles
b. Provide public access to streams	112 miles	112 miles	112 miles	112 miles	-	112 miles
c. Change land from private to public uses.	9,415 acres	7,230 acres	4,650 acres	2,550 acres	-	4,650 acres
d. Reduce soil loss	426,400 acres	426,400 acres	426,400 acres	426,400 acres	426,400 acres	426,400 acres
e. Remove land from crop production	4,200 acres	3,100 acres	2,100 acres	1,050 acres	25,300 acres	2,100 acres
3. Biological Resources and Selected Ecosystems.						
a. Disrupt aquatic ecosystem	320 miles	320 miles	320 miles	320 miles	415 miles	320 miles
b. Maintain riparian wildlife habitat	320 miles	320 miles	320 miles	320 miles	635 miles	320 miles
c. Establish or improve wildlife cover	1,450 acres	922 acres	742 acres	552 acres	25,300 acres	922 acres
d. Protect wildlife and wetland habitat	640 acres	16,523 acres	488 acres	438 acres	150,000 acres	16,523 acres
e. Change riparian wildlife habitat to open channel or grass	380 acres	234 acres	234 acres	64 acres	-	234 acres
f. Replace wildlife habitat with public recreational facilities	688 acres	450 acres	315 acres	160 acres	-	315 acres
C. Regional Development						
1. Income						
Beneficial Effects ($)	26,650,600	20,774,800	13,866,500	8,608,700	955,700	20,134,300
Adverse Effects ($)	6,829,600	6,345,500	4,597,300	3,142,800	2,629,400	7,115,600
Net Beneficial Effects ($)	19,821,000	14,429,300	9,269,200	5,465,900	-1,673,700	13,018,700
2. Employment						
Permanent jobs	60	52	36	23	5	53
Seasonal jobs	23	18	12	7	-	7
Temporary jobs (man-years)	5,099	3,666	2,874	1,991	792	3,522
D. Social Well-Being						
1. Employment (See C.2 above)						
2. Regional Income and Costs (See C.1. above)						
3. Provide agricultural flood protection (acres)	153,000	146,520	85,280	62,640	-	146,520
4. Provide recreational opportunities for rural and urban population of region (recreation visits)	3,362,000	1,977,500	1,211,950	915,960	-	1,211,950

1/ Excludes increased production benefits attributable to drainage.

TABLE IX - 13 CAPABILITY OF ALTERNATIVES TO SATISFY NEEDS
Kankakee River Basin, Indiana

OBJECTIVES		ALTERNATIVES - COMPONENT NEEDS PROVIDED AND REMAINING											
Component Needs (Early Action-1990)		A (NED)		B		C		D		E (EQ)		Suggested Alternative	
Description and Units	Quantity	Provides	Remaining	Provides	Remaining	Provides	Remaining	Provides	Remaining	Provides	Remaining	Provide	Remaining
NED													
1. Flood Damage Reduction from channel work													
(Acres)	180,100	153,000	27,100	146,520	33,580	85,280	94,820	62,640	117,460	-0-	180,100	146,520	33,580
(Damage/yr) 1/	2,509,600	1,342,100	1,167,500	1,173,200	1,336,400	802,400	1,707,200	439,400	2,070,200	-0-	2,509,600	1,173,200	1,336,400
2. Drainage - Improved Farming Efficiency (Acres)	439,350	330,000	109,350	247,500	191,850	165,000	274,350	82,500	356,850	-0-	439,350	247,500	191,850
3. Acc. Land Treatment													
Sheet Erosion Control (Acres Cropland)	171,120	100,050	71,070	100,050	71,070	100,050	71,070	100,050	71,070	100,050	71,070	100,050	71,070
Adequate Treatment (Acres)	683,300	426,400	256,900	426,400	256,900	426,400	256,900	426,400	256,900	426,400	256,900	426,400	256,900
4. Outdoor Recreation													
Camping (Ac.)	2,824	168	2,656	126	2,698	84	2,740	42	2,782	-0-	2,824	84	2,740
Trails (Mi.) 2/	1,479	218	1,261	144	1,335	57	1,422	57	1,422	-0-	1,479	57	1,422
Playfields (Ac.)	2,482	220	2,262	155	2,327	110	2,372	55	2,427	-0-	2,482	110	2,372
Canoeing (Mi.)	326	112	214	112	214	112	214	112	214	-0-	326	112	214
Golfing (Ac.)	3,885	720	3,165	600	3,285	360	3,525	240	3,645	-0-	3,885	360	3,525
Hunting (Ac.)	133,000	-0-	133,000	-0-	133,000	-0-	133,000	-0-	133,000	-0-	133,000	-0-	133,000
EQ													
1. Acc. Land Treatment													
Sheet Erosion Control (Acres Cropland)	171,120	100,050	71,070	100,050	71,070	100,050	71,070	100,050	71,070	100,050	71,070	100,050	71,070
Adequate Treatment (Acres)	683,300	426,400	256,900	426,400	256,900	426,400	256,900	426,400	256,900	426,400	256,900	426,400	256,900
2. Protect Classified Wetlands (Acres)	10,000	-0-	10,000	-0-	10,000	-0-	10,000	5,000	5,000	10.000	-0-	5,000	5,000
3. Protect Existing Woodland Habitat (Acres)	140,000	-0-	140,000	-0-	140,000	50,000	90,000	100,000	40,000	140,000	-0-	100,000	40,000
4. Protect and Improve Fisheries and Riparian Wildlife Habitat-Miles	635	-0-	635	-0-	635	63	572	254	381	635	-0-	254	381
5. Management of Flood Prone Areas (Acres)	222,450	222,450	-0-	222,450	-0-	222,450	-0-	222,450	-0-	222,450	-0-	222.450	-0-

1/ In addition $155,000 of future flood prevention from floodplain zoning is attributable to each alternate.
2/ Includes: Bicycling - 119 miles, Bridle - 465 miles, Nature - 321 miles, and Hiking - 574 miles.

TABLE IX-14 CAPABILITY OF PLAN ELEMENTS AND ALTERNATIVES TO SATISFY NEEDS 1/

Kankakee River Basin, Indiana

	NEEDS		PORTION OF NEEDS PROVIDED FOR BY ALTERNATIVES 2/				
			A	B	C	D	E
NED	Flood Protection - (Acres)	180,000	85%	81	47	35	
	Ave. Ann. Damage ($)	2,664,600	53	47	32	18	
	Accelerated Land Treatment (Acres) (On-Farm Drainage)	439,350	75	56	38	19	
	Accelerated Land Treatment (Acres) (Excluding drainage)	674,500	75	75	75	75	75
	Recreation - (Activity Days)	21,850,000	15	9	6	4	
	Flood Plain Management (Acres)	222,450	100%				
EQ	Protection Classified Wetlands (Acres)	10,000				50	100
	Protection Woodland Habitat (Acres)	140,000			36	71	
	Changed Land Use for erosion control and adequate land treatment (Acres)	25,300			50	50	
	Maintenance, improvement and protection of stream fisheries and riparian habitat (Miles)	635			10	40	
	Preservation of Flood Plain Natural Areas (Acres)	14,000					

1/ Contains plan elements of "Suggested Plan."
2/ 85 Figures represent the percentage of identified needs satisfied by the plan elements associated with a specific alternative.

Further discussion will deal in generalities with those elements in the "Suggested Plan" and other alternatives.

1. Environmental Impact of "Suggested Plan"

   The environmental quality account on sheet 2 of Table IX-11 provides a summary of environmental impacts of the"Suggested Plan" provided full implementation occurs.

2. Beneficial Effects of "Suggested Plan"

   The beneficial effects are numerous, therefore, the reader is referred to Tables IX-11 sheet 2 of 5 (Environmental Quality Account) where all physical effects are listed. Some of the beneficial effects include:

   a) Preserve 222,000 acres of flood plains for agricultural, natural, or recreational uses.
   b) Provide 1400 acres of protected area for wildlife use.
   c) Decrease agricultural nutrient contribution to streams.
   d) Establish 922 acres of permanent wildlife cover.

   Additional beneficial effects may include those physical effects listed on Table IX-11, page 2 of 5 and not included in Item 3 below.

3. Adverse Effects of "Suggested Plan"

   a) Create some additional flooding and consequent damages downstream from U. S. Route 41 due to projected increase of flood stages is included as a cost in Table IX-13.

   b) Disrupt tranquility of rural environment by providing public access and recreation activities for 1,211,950 recreation visits.

   c) Extend public access to 112 miles of stream for canoeing and fishing.

   d) Temporary disruption of aquatic ecosystem on 340.5 miles of stream.

   e) Temporary disruption of aesthetic quality and temporary increase in fire hazard from Timber Stand Improvement practices.

   f) Replace 450 acres of wildlife habitat with public recreation facilities.

   g) Change 234 acres of riparian wildlife habitat to open channel or grass.

   These effects are listed sheet 2 of 5 in Table IX-11.

4. Alternates

Alternatives considered in meeting component needs to satisfy the NED and EQ objectives are discussed under previous portions of this chapter and are displayed in Tables IX-5 through IX-9 and IX-11. Comparisons are presented in Tables IX-12, IX-13, and IX-14. The effects of a "no action" alternative can be quantified by referring to the Component Needs (Early Action - 1990) on Table IX-13. Those quantities reflect remaining need if no recommendations for development are implemented.

5. Short-Term vs. Long-Term Use of Resources

With the possible exception of an increase in urban and built-up areas, current trends do not indicate rapid change in land use unless specific project-type action stimulates such a change. Flood prone areas and other areas at or near stream channels are, for the most part, now used for agricultural activity and for natural or aesthetic purposes.

The development of county parks could affect a significant acreage of cropland. This estimate is speculative until local decisions are made for implementation of such parks. Additional acreages of other land use would be utilized for the remainder of the county park areas.

Suggested recreation or corridor developments along streams would involve additional acreage, none of which is now developed or used for agricultural production. In addition, some wildlife habitat could be replaced with recreation facilities. Other recommended recreation and corridor developments are not expected to change land uses.

The projected uses of land with development of the suggested plan are considered generally compatible with existing plans for land use in the Basin, with one major exception. The recommendation for conversion of up to 12,650 acres of cropland to grassland and forestland as proposed in the "Suggested Plan", would result in a reduced net return to the landowners on a short-term basis. Accelerated land treatment on more productive lands would enhance the land resource base and provide continued long-term production. This action would assure adequate cropland to meet projected demands for agricultural production in the Basin. Continued application of conservation measures to the land will assure a fertile resource base for future generations.

6. Irreversible and Irretrievable Commitments of Resources

Land use changes considered detrimental to the natural environment are indicated in Tables IX-5 through IX-9 and IX-11, Environmental quality Accounts. In this alternative wildlife habitat would

be replaced with recreation facilities and riparian wildlife habitat would be changed to open channel or grass with implementation of recommended flood prevention measures. Local decisions which would lead to development of recommended actions would not preclude optional use of the areas involved at any time in the future, should circumstances dictate the need for such changes. However, for purposes of this report, the irreversible and irretrievable commitments for the "Suggested Plan" are evaluated in terms of the 100-year project evaluation period and listed on Sheet 2 of 5 of Table IX-11. Recommended recreation or corridor developments along streams would involve about 2500 acres, none of which are now developed or used for agricultural production. About 240 acres of wildlife habitat would be replaced with recreation facilities. Other recommended recreation and corridor developments are not expected to change land uses.

E. Additional Recommendations for On-going Programs

In addition to the opportunities for development to meet the NED and EQ objectives, there are several on-going programs which should be continued or authorized programs which should be initiated in the best interests of Basin residents. These additional recommendations are for action by state and/or local government, and they are not classified as new planning elements for project action.

They are:

1. The Indiana Department of Natural Resources should continue their program of analyzing natural lake levels and the need for control structures and/or outlet channel work.

2. County Drainage Boards should accelerate implementation of their authority under the 1965 Indiana Drainage Law, as amended, in order to aid numerous landowners which have small isolated areas that need channel deepening for an adequate drainage outlet.

3. Implement the Federal Flood Insurance program in all areas of the Basin. Several eligible jurisdictions within the Basin are now participating.

4. Public and private water supply utilities should increase utilization of the ground-water resource with additional wells and expanded distribution system to meet projected demands for municipal and industrial water supply.

5. Water supply utilities should continue to refine water processing in municipal systems to meet the desires of the people.

6. Individuals and water supply utilities shoud increase utilization of the ground-water resource to meet projected demands for rural water.

7. All regulatory agencies such as the Stream Pollution Control Board should implement compliance schedules to meet municipal, industrial, and semi-public wastewater treatment needs, and implement a continuing development program to improve and protect surface water quality.

8. The Indiana State Board of Health should continue and expand the surveillance necessary to effectively control and improve water quality.

9. Maintain enforcement of Stream Pollution Control Board water quality standards.

10. Appropriate authorities should continue to analyze lake developments and the necessity or advisability of central sewage disposal systems.

11. Expand the National Eutrophication Survey to study the tropic nature and water quality of all public lakes and reservoirs of significant size.

12. The Indiana Department of Natural Resources should continue and complete inventories and fish management plans for public areas.

13. Complete inventories and fish management plans on streams.

14. The Indiana Department of Natural Resources should continue to acquire natural areas and preserves in accordance with their established priority rating.

15. Continue survey of important archaeological sites and record them in the files of the Glen A. Black Laboratory of Archaeology at Indiana University.

16. Encourage local zoning authorities to consider the protection of mineral deposits for future use when developing zoning restrictions.

X. POTENTIAL FOR DEVELOPMENT OF RECOMMENDATIONS

A. USDA Programs X - 1

B. Other Programs X - 2

CHAPTER X. POTENTIAL FOR DEVELOPMENT OF RECOMMENDATIONS

A. USDA Programs

1. Land Treatment Program Under PL-46 and Other Related Authorities

The need for accelerated land treatment has been identified and recommended. Technical assistance under the authority of PL-46 can be provided by the Soil Conservation Service (SCS) to individuals or groups of landowners and operators in rural and urban areas. Such assistance is coordinated by local soil and water conservation districts under authority of state law. Related activities include cost-sharing provisions available through the Agricultural Stabilization and Conservation Service (ASCS) to cooperating farmers in implementing soil, water, woodland, and wildlife conservation practices on farmland currently in agricultural production.

The recommended accelerated land treatment program is planned to satisfy about 75 percent of total identified needs. Technical and financial assistance available through SCS and ASCS will serve as stimuli toward the implementation of this program.

2. Cooperative State-Federal Forestry Programs

The Cooperative Forest Management Program involves the U.S. Forest Service and the Indiana Department of Natural Resources (IDNR)-Division of Forestry, in providing advice and other technical assistance for approved forest management practices on private lands. This program will be valuable in meeting the need for conversion of cropland to forestland on those areas of excessive soil erosion and areas otherwise more suited to the growth of forest products.

3. Potential PL 83-566 Projects

Planning assistance for water and related land resource projects is available through the Soil Conservation Service under the Watershed Protection and Flood Prevention Act (PL 83-566). Results of this study indicate that thirteen small watersheds have potential for development under PL-566. One of the identified potentials (Bailey Ditch or Bailey-Cox-Newtson Watershed) in Starke County is authorized for planning. Six others (Benkie Ditch, Breyfogel Ditch, Crooked Creek, Phillips-Cornell Ditch, Sandy Hook Ditch, and Robbins Ditch) have applications pending.

4. Resource Conservation and Development Projects

Resource conservation and development (RC&D) projects are available in approved areas where acceleration of current resource conservation programs will increase local economic activity.

The projects provide technical, financial, and loan assistance to legal sponsors of approved projects. These projects are authorized by Public Law 87-703.

The Kankakee River Basin in Indiana includes one RC&D project. The Arrow Head Country RC&D Project was authorized in February 1975, and includes the counties of Newton, Jasper, Starke, and Pulaski. Assistance under this program can help meet the identified needs for public water-based recreation, fish and wildlife habitat, critical area treatment, flood prevention, land drainage, farm irrigation, and agricultural related pollution sources.

5. Rural Credit Programs

The Farmers Home Administration's (FmHA's) rural credit programs provide assistance to help build the family farm system, the economic and social base of many rural communities; to expand business and industry, increase income and employment, and control or abate pollution; to install water and waste disposal systems and other community facilities that help rural areas upgrade the quality of living and promote economic development and growth; and to provide or improve modest homes in suitable rural environments at prices and on terms that families of low or moderate income can afford. Federal Extension Service specialists work with other agencies to provide information relating to soil and water conservation programs and technical assistance in analyzing recreational needs and developments.

B. Other Programs

1. Other Agency Programs

The Natural Resources Commission has regulatory authority over all flood control in the state and regulation of development within floodways. Rules and regulations governing use of the floodway and floodway fringe are now in effect and can be adopted by local ordinance. The implementation of these rules and regulations in this Basin would help reduce future flood damages within the Kankakee River floodway.

The Division of Outdoor Recreation, IDNR, administers grant funds, available from the U.S. Bureau of Outdoor Recreation, to provide for acquisition and/or development of recreational facilities. This program is a potential source of aid in implementing the parks and riverside recreation development.

The Division of Fish and Wildlife, IDNR, administers funds available through the U.S. Fish and Wildlife Service, for purchase and management of classified wetlands. This program, in addition to a similar program carried out by the Division, will help implement the measures for protecting certain classified wetlands.

The 13 Soil and Water Conservation Districts (SWCD's), organized throughout the Kankakee River Basin, are actively promoting the current program of installing needed conservation measures on individual farms. The SWCD's are expected to support the recommendation for accelerating installation of the land treatment program.

County drainage boards have authority to assist landowners with major open channel drainage measures and should be considered a primary source of assistance in accelerating the installation of needed drainage systems.

The State Board of Health and the Stream Pollution Control Board are actively involved in a number of programs to maintain and improve the quality of water in the Basin. The Stream Pollution Control Board now conducts stream surveys in various waters within the state as part of its data collection program. Likewise, samples are collected from 86 stations in Indiana streams and lakes.

Chapter 273, Acts of 1967, requires the classification of wastewater treatment plants and certification of plant supervisors. The frequency of inspections of wastewater treatment facilities by representatives of the Board has been increased and will be increased even more to insure compliance with the standards. The prompt and regular submission of monthly operational reports will be required of the treatment plant personnel for purposes of evaluating the effluent quality. Furthermore, where practicable, the Board will require a downstream sampling program at the larger facilities.

The National Pollutant Discharge Elimination System (NPDES) permit program is a federally required program for the issuance of permits for all point discharges into waterways within the State of Indiana. The program was initiated on October 18, 1972, as part of the Federal Water Pollution Control Act Amendment of 1972.

The Stream Pollution Control Board Regulation SPC 15 gives the state authority to issue permits for all point discharges. Discharge permits which will satisfy both the NPDES and SPC 15 discharge requirements will be issued.

The Environmental Protection Agency has established an intensive survey (National Eutrophication Survey) to identify the water bodies in the United States which have potential or actual eutrophication problems due to phosphorus from municipal sources. Results of the survey are an integral part of an Environmental Protection Agency control program to assist state and local governments, through construction grants, in reducing phosphates to the extent necessary to protect water quality by means of municipal waste treatment. Under this control program, 80-98 percent phosphate removal may be provided at municipal treatment plants, where required.

In addition to the federally sponsored National Eutrophication Survey, the Indiana State Board of Health - Division of Water Pollution Control, plans a 5-year study which will provide information regarding

the trophic nature of all public lakes and reservoirs of significant size in the state. While many of the methods employed are similar to those used by the National Eutrophication Survey, the surveys will not initially involve the collection of more than one set of samples from each lake or its tributaries. In addition, it will be possible to conduct algae assays of the lake water at this time; however, the surveys will identify those public lakes and reservoirs which are apparently being enriched at an excessive rate. All lakes will be identified relative to their unique character or special ecological significance. Following the collection and analyses of a sufficient quantity of survey data, the water quality criteria and plan of implementation will be reevaluated using the new information.

The flooding problems of the communities of Schneider, Shelby, Sumava Resorts, Shady Acres and Wildwood are such that solutions will apparently require special complex measures, as alluded to in Section VII. Level C (implementation-type) studies will be required to recommend specific solutions to these problem areas. Flood protection for such areas could be considered under the category of "local protection projects" which are administered by the U.S. Army Corps of Engineers.

2. Projects Needing Further Coordination

Flood protection work on the Kankakee River Main Stem by a federal agency could be under the jurisdiction of the U.S. Army Corps of Engineers. Any construction activity would first require additional detailed implementation type (Level C) studies including the preparation of an environmental impact statement. Such an implementation study would require close coordination between the States of Illinois and Indiana. In addition, plan commissions, governing councils, park and recreation boards, and other special districts will need to carefully consider all alternatives to assure proper and efficient development, operation, and maintenance of these works of improvement.

The riverside recreation development provides a unique combination of providing public use of the major stream while meeting part of the need for nonstructural flood control measures. Making such public areas a reality will require a coordinated effort among local agencies and with individual landowners. The city and county park and recreation boards, plan commissions, governing councils, and other special districts will need to consider carefully the extent and use of such areas and enact ordinances to assure proper development, operation, and maintenance.

Classified wetlands are a unique natural resource of this Basin, but the protection of those areas for future generations to enjoy will require careful consideration of the present landowners and the impact of purchase or long-term lease on adjacent lands. A new program similar to the Classified Forest Program should be considered as one method of implementing this recommendation for the Basin.

GLOSSARY

GLOSSARY

1. Accelerated Land Treatment

   The installation of land treatment (See LT) at an earlier date, or more rapid rate, than would be effected under existing programs and conditions. This term may be used to refer to the additional land treatment accomplished in a particular time frame or by a given date, as compared with the norm.

2. Activity Day

   A statistical unit of recreation use by one person in pursuit of a single activity for all or part of one 24-hour period.

3. Average Annual Benefits

   The mean yearly advantage during the evaluation period. Does not consider costs.

4. Average Annual Costs

   The mean yearly expense during the evaluation period.

5. Comprehensive River Basin Studies

   Studies to provide a guide for state, federal, and local interests to conserve, develop, and utilize their water and related land resources in an efficient and timely manner. Their objectives are to enhance national economic development and to enhance the quality of the environment.

6. Recreation Demand

   The desire of people to participate in recreational activities. The demands are projected through the use of participation rates, as developed in 1973 by the Indiana Department of Natural Resources, Division of Outdoor Recreation.

7. Environmental Corridors

   Linear areas reserved for managed use and left in or developed to a condition that can enhance man's environment by maintaining or creating scenic beauty, wildlife habitat, natural areas, open space, recreational opportunities, flood hazard reduction, water quality improvement, and other desirable features in total or in any part.

8. Environmental Quality

This objective reflects society's concern and emphasis for the natural environment and its maintenance and enhancement as a source of present enjoyment and a heritage for future generations. Components of the Environmental Quality objective may include areas of natural beauty; quality of water, land, and air; biological resources and ecosystems; geological, archeological, and historic resources.

9. Flood Hazard Areas

Those flood plains which have not been adequately protected from flooding either by structural or non-structural means.

10. Flood Plain

The area adjoining a river, stream, or lake which has been or may hereafter be covered by floodwater.

11. Floodway

The channel of a river or stream and those portions of the flood plains adjoining the channel which are reasonably required to efficiently carry and discharge the peak flood flow of the regional flood of any river or stream.

12. Floodway Fringe

Those portions of the flood hazard areas lying outside the floodway.

13. Land Treatment

The application of conservation management and practices on areas of cropland, pastureland, forestland, and other land. Land treatment includes land use planning, as well as the installation of engineering and agronomic measures, with the intent of conserving and improving the soil and water resources.

14. National Economic Development (NED)

Increases or decreases in the nation's productive output. Beneficial effects are increased goods and services and improvements in economic efficiency. Adverse effects are the value of resources required or displayed by the plan.

15. Natural Areas

This consists of areas of unique natural conditions with little developed facilities. Areas are selected for designation on the basis of the resource rather than on the utilization for recreation purposes.

16. Nature Preserves

Areas that preserve a singly unique geologic feature or extensive ecological communities.

17. Natural Streams

Those streams in an unaltered and unpolluted condition.

18. Need

The difference between demand and supply when demand is greater than supply.

19. Participation Rate

The results of one person participating in one activity for at least one-half hour of any one day.

20. Principles and Standards

Principles - provide the broad policy framework for planning activities and include the conceptual basis for planning.
Standards - provide for uniformity and consistency in comparing, measuring, and judging beneficial and adverse effects of alternative olans.

21. Recreation Areas

Such areas as scenic, hunting and fishing, national and state forests, parks, monuments, refuges, drives, and campgrounds.

22. Regional Development (RD)

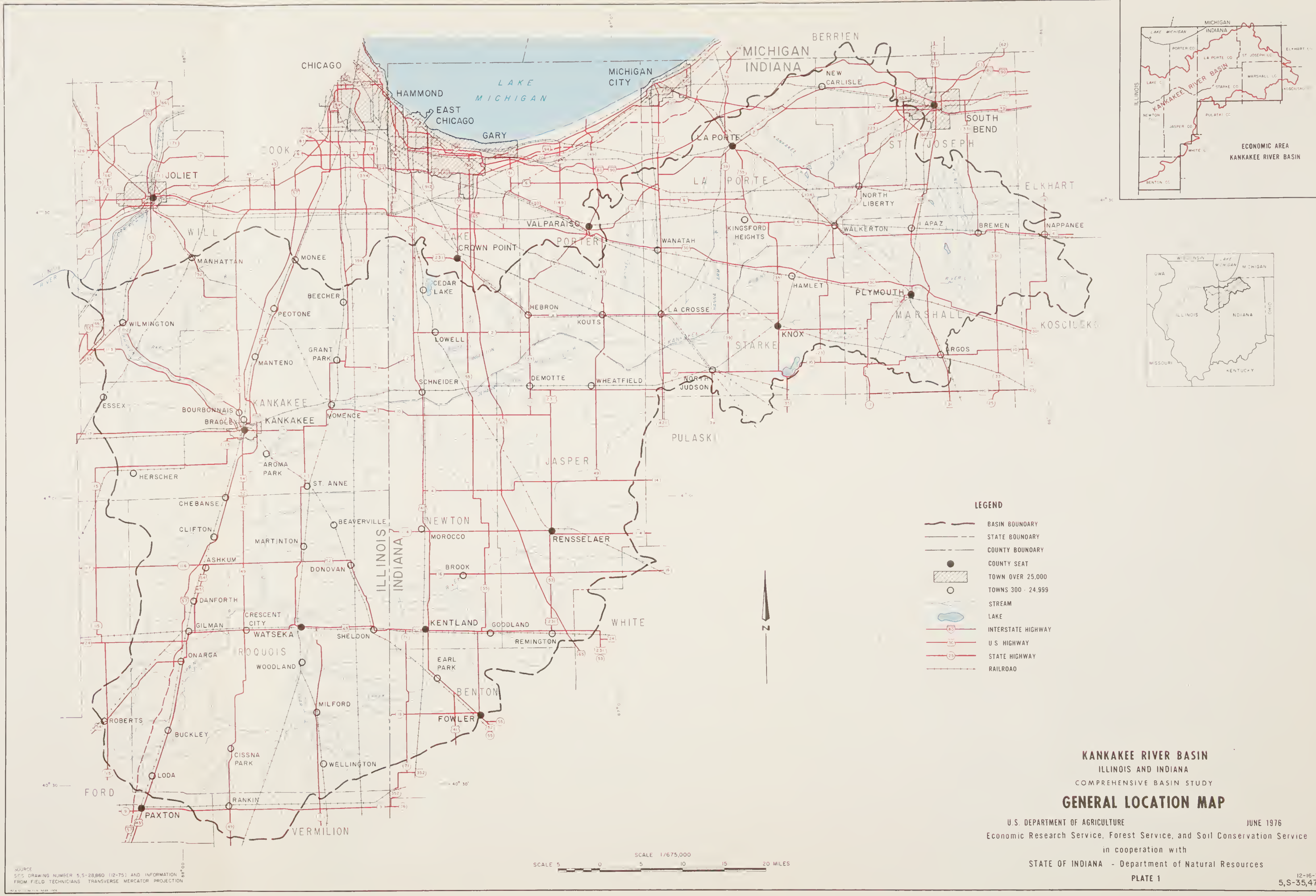
Increases or decreases in the region's production output. The region encompasses all areas that will be physically affected by the plan and all contiguous counties that will incur significant economic effects. See NED.

23. Social Well-Being

Effects which are integrally related to the basic values and goals of society and which are usually not subject to monetary evaluation. These include effects on real income; security of life, health, and safety; education; culture; and recreation.

PLATES

Plate	
1	General Location Map
2	General Soil Map
3	Soil Interpretations
4	Generalized Surficial Geologic Map
5	Bedrock Geology
6	Hydrologic Data Network
7	Geologic Cross Sections
8	Ground Water Availability Map
9	Bedrock Topography Map
10	Ground Water Level Map
11	Saturated Thickness of the Kankakee Aquifer
12	Major Wetland Areas
13	Riparian Wildlife Habitat
14	Stream Fisheries Habitat
15	Environmental and Recreation Map
16	Small Watershed Projects
17	Flooded Area Map
18	Main Stem Flood Protection Systems
19	Recreation Trails



KANKAKEE RIVER BASIN
ILLINOIS AND INDIANA
COMPREHENSIVE BASIN STUDY

GENERAL LOCATION MAP

U.S. DEPARTMENT OF AGRICULTURE JUNE 1976
Economic Research Service, Forest Service, and Soil Conservation Service
in cooperation with
STATE OF INDIANA - Department of Natural Resources

PLATE 1

12-16-75
5,S-35,475

SOIL ASSOCIATIONS

AREAS DOMINATED BY EXCESSIVELY DRAINED AND WELL-DRAINED, SLOPING, SANDY AND LOAMY SOILS

1 Plainfield-Chelsea association: Sloping, excessively drained, sandy soils formed in windblown sands.

2 Oshtemo-Plainfield association: Sloping, excessively drained, sandy Plainfield in windblown sands and well-drained, loamy Oshtemo formed in outwash sand and gravel.

3 Hillsdale-Oshtemo association: Sloping, well-drained, loamy Hillsdale in glacial till, and well-drained, loamy Oshtemo formed in outwash sand and gravel.

4 Riddles-Miami-Owosso association: Sloping, well-drained, loamy soils formed in glacial till.

AREAS DOMINATED BY WELL-DRAINED, NEARLY LEVEL, LOAMY SOILS

5 Door-Lydick association: Nearly level, well-drained, loamy soils formed in shaley outwash sand and gravel.

6 Fox-Oshtemo association: Nearly level, well-drained, loamy soils formed in outwash sand and gravel.

7 Genesee-Eel association: Nearly level, well-drained, loamy Genesee and moderately well-drained, loamy Eel formed in alluvial deposits.

8 Volinia-Dowagiac association: Nearly level, well-drained, loamy soils formed in outwash sand and gravel.

AREAS DOMINATED BY WELL-DRAINED, SOMEWHAT POORLY DRAINED AND VERY POORLY DRAINED, NEARLY LEVEL AND SLOPING, LOAMY AND CLAYEY SOILS

9 Morley-Blount-Pewamo association: Sloping, well-drained, clayey Morley and nearly level, somewhat poorly drained, clayey Blount and very poorly drained, clayey Pewamo formed in glacial till.

10 Markham-Elliott-Pewamo association: Sloping, well-drained, clayey Markham and nearly level, somewhat poorly drained, clayey Elliott and very poorly drained, clayey Pewamo formed in glacial till.

11 Tracy-Lydick-Rensselaer association: Nearly level, well-drained, loamy Tracy and Lydick formed in shaley outwash sand and gravel, and very poorly drained Rensselaer formed in lake deposited sand and silt.

12 Miami-Crosier-Brookston association: Sloping, well-drained, loamy Miami, nearly level, somewhat poorly drained, loamy Crosier and very poorly drained, loamy Brookston formed in glacial till.

13 Martinsville-Whitaker-Gilford association: Nearly level and sloping, well-drained, loamy Martinsville, nearly level, somewhat poorly drained loamy Whitaker and nearly level, very poorly drained, loamy Gilford formed in outwash or lake-deposited sand and silt.

14 Wea-Westland-Pewamo association: Nearly level, well-drained loamy Wea, and very poorly drained, loamy Westland formed in outwash sand and gravel and very poorly drained, clayey Pewamo formed in glacial till.

AREAS DOMINATED BY VERY POORLY DRAINED, NEARLY LEVEL, ORGANIC SOILS

15 Mucks and peats: Nearly level, very poorly drained soils formed in deep deposits of organic materials.

AREAS DOMINATED BY SOMEWHAT POORLY DRAINED AND VERY POORLY DRAINED, NEARLY LEVEL SOILS

AREAS DOMINATED BY SANDY SOILS

16 Maumee-Rensselaer-Gilford association: Nearly level, very poorly drained, sandy Maumee and loamy Rensselaer and Gilford formed in outwash or lake-deposited sand and silt.

17 Maumee-Plainfield association: Nearly level, very poorly drained, sandy Maumee formed in outwash or lake-deposited sands and sloping, excessively drained, sandy Plainfield formed in windblown sands.

18 Maumee-Plainfield-Morocco association: Nearly level, very poorly drained, sandy Maumee formed in outwash or lake deposited sands and sloping excessively drained sandy Plainfield and nearly level somewhat poorly drained, sandy Morocco formed in windblown or outwash sands.

19 Conrad-Wooten-Weiss association: Nearly level, somewhat poorly drained, sandy Weiss and poorly drained, sandy Conrad and Wooten formed in mixed sandy and organic strata in lakebeds.

AREAS DOMINATED BY LOAMY SOILS

20 Brookston-Parr-Odell association: Nearly level, very poorly drained, loamy Brookston, well-drained Parr, and somewhat poorly drained Odell formed in glacial till.

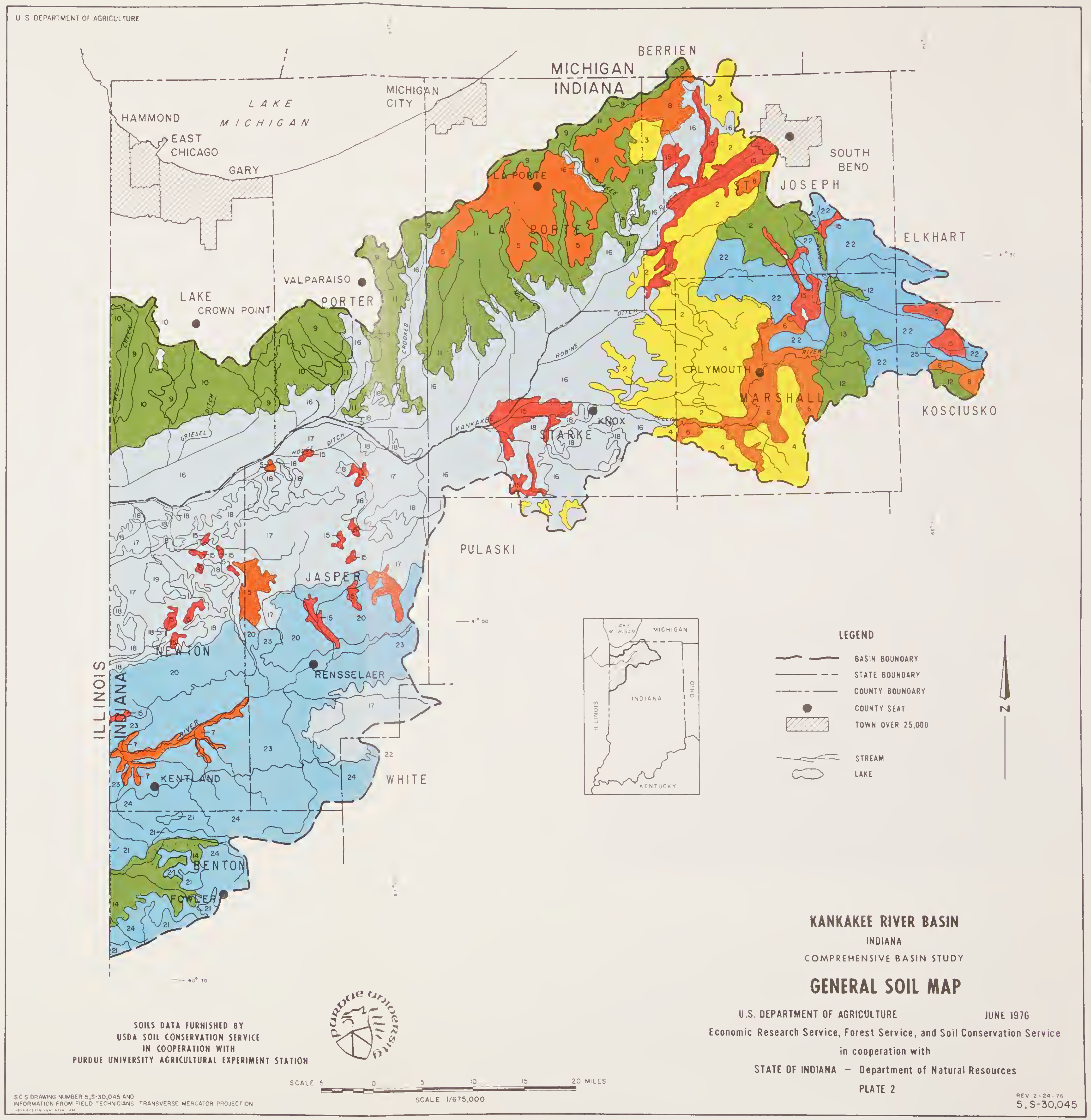
21 Brookston-Parr-Corwin association: Nearly level, very poorly drained, loamy Brookston, well-drained Parr and moderately well-drained Corwin formed in glacial till.

22 Crosier-Brookston association: Nearly level, somewhat poorly drained, loamy Crosier and very poorly drained, loamy Brookston formed in glacial till.

23 Rensselaer-Darroch association: Nearly level, very poorly drained, loamy Rensselaer and somewhat poorly drained, loamy Darroch formed in outwash or lake-deposited sand and silt.

24 Brookston-Odell association: Nearly level, very poorly drained, loamy Brookston and somewhat poorly drained, loamy Odell formed in glacial till.

25 Mussey-Sebewa-Mucks association: Nearly level, very poorly drained, loamy Mussey and Sebewa formed in outwash sand and gravel, and Mucks formed in deep deposits of organic materials.



KANKAKEE RIVER BASIN, INDIANA

ESTIMATED SOIL LIMITATIONS OR SUITABILITY FOR SELECTED USES

SOIL ASSOCIATION	SOIL SERIES AND PERCENT OF ASSOCIATION		DWELLINGS		WASTE DISPOSAL		LOCAL ROADS, STREETS, AND PARKING AREAS	SUITABILITY AS A SOURCE OF			RECREATION		INTENSIVE CROPPING	WOODLAND PRODUCTIVITY
	SOIL SERIES	PCT	WITH BASEMENTS	WITHOUT BASEMENTS	SEPTIC TANK ABSORPTION FIELDS	SEWAGE LAGOONS		SAND	GRAVEL	ROADFILL	CAMP AND PICNIC AREAS	PLAYGROUNDS & ATHLETIC FIELDS		
1	PLAINFIELO CHELSEA MINOR	22 12 66	MODERATE: 1 MODERATE: 1	MODERATE: 1 MODERATE: 1	MODERATE: 1 MODERATE: 1	SEVERE: 1,7 SEVERE: 1,7	MODERATE: 1 MODERATE: 1	GOOD FAIR	UNSUITED UNSUITED	GOOD GOOD	MODERATE: 1,6 MODERATE: 1,6	SEVERE: 1 SEVERE: 1	POOR POOR	POOR POOR
2	OSHTEMO PLAINFIELD MINOR	27 14 59	MODERATE: 1 MODERATE: 1	MODERATE: 1 MODERATE: 1	MODERATE: 1 MODERATE: 1	SEVERE: 1,7 SEVERE: 1,7	MODERATE: 1 MODERATE: 1	GOOD GOOD	GOOD UNSUITED	GOOD GOOD	MODERATE: 1 MODERATE: 1,6	SEVERE: 1 SEVERE: 1	FAIR POOR	POOR POOR
3	HILLSOALE OSHTEMO MINOR	36 35 29	MODERATE: 1 MODERATE: 1	MODERATE: 1 MODERATE: 1	MODERATE: 1 MODERATE: 1	SEVERE: 1,7 SEVERE: 1,7	MODERATE: 1,6 MODERATE: 1	UNSUITED FAIR	UNSUITEO GOOD	FAIR GOOD	MODERATE: 1 MODERATE: 1	SEVERE: 1 SEVERE: 1	FAIR FAIR	GOOD POOR
4	RIDDLES MIAMI OWOSSO MINDR	33 17 11 39	MODERATE: 1 MODERATE: 1 MODERATE: 1	MODERATE: 1 MODERATE: 1 MODERATE: 1	MODERATE: 1,2 MODERATE: 1,2 MODERATE: 1	SEVERE: 1 SEVERE: 1 SEVERE: 1,7	MODERATE: 5,6 MODERATE: 5,6 MODERATE: 1,6	UNSUITED UNSUITED UNSUITED	UNSUITED UNSUITEO UNSUITED	FAIR FAIR FAIR	MODERATE: 1 MODERATE: 1 MOOERATE: 1	SEVERE: 1 SEVERE: 1 SEVERE: 1	GOOD GOOD FAIR	GOOD GOOD GOOD
5	DOOR LYDICK MINOR	57 31 12	SLIGHT SLIGHT	SLIGHT SLIGHT	SLIGHT SLIGHT	SEVERE: 7 SEVERE: 7	MODERATE: 6 MODERATE: 6	FAIR FAIR	UNSUITED UNSUITED	POOR POOR	SLIGHT SLIGHT	SLIGHT SLIGHT	GOOD FAIR	NO OATA AVAIL. NO OATA AVAIL.
6	FOX OSHTEMO MINOR	24 22 54	SLIGHT SLIGHT	SLIGHT SLIGHT	SLIGHT SLIGHT	SEVERE: 7 SEVERE: 7	SLIGHT SLIGHT	GOOD GOOD	GOOD GOOD	GOOD GOOD	SLIGHT SLIGHT	MODERATE: 1 SLIGHT	FAIR FAIR	GOOD POOR
7	GENESEE EEL MINOR	52 10 38	SEVERE: 4 SEVERE: 4	SEVERE: 4 SEVERE: 4	SEVERE: 4 SEVERE: 4	SEVERE: 4,7 SEVERE: 4,7	SEVERE: 4 SEVERE: 4	UNSUITED UNSUITED	UNSUITED UNSUITED	FAIR FAIR	SEVERE: 4 SEVERE: 4	SEVERE: 4 SEVERE: 4	GOOD GOOD	GOOD GOOD
8	VOLINIA DOWAGIAC MINOR	42 23 35	SLIGHT SLIGHT	SLIGHT SLIGHT	SLIGHT SLIGHT	SEVERE: 7 SEVERE: 7	SLIGHT SLIGHT	GOOD FAIR	GOOD FAIR	GOOD GOOD	SLIGHT SLIGHT	SLIGHT SLIGHT	FAIR FAIR	NO DATA AVAIL. NO DATA AVAIL.
9	MORLEY BLOUNT PEWAMO MINOR	41 14 11 34	MODERATE: 5 SEVERE: 3 SEVERE: 3	MODERATE: 5 MODERATE: 3,5 SEVERE: 3	SEVERE: 2 SEVERE: 2,3 SEVERE: 2,3	MODERATE: 1 SLIGHT SEVERE: 3	SEVERE: 5,6 SEVERE: 5,6 SEVERE: 3,5,6	UNSUITED UNSUITED UNSUITED	UNSUITED UNSUITED UNSUITED	POOR POOR POOR	SLIGHT MODERATE: 3 SEVERE: 3	MODERATE: 1,2 MODERATE: 2,3 SEVERE: 2,3	FAIR FAIR GOOD	GOOD FAIR FAIR
10	MARKHAM ELLIOTT PEWAMO MINOR	36 24 16 24	SLIGHT SEVERE: 3 SEVERE: 3	MODERATE: 6 MODERATE: 3,6 SEVERE: 3	SEVERE: 2 SEVERE: 2,3 SEVERE: 2,3	SLIGHT MODERATE: 3 SEVERE: 3	SEVERE: 5,6 SEVERE: 5,6 SEVERE: 3,5,6	UNSUITED UNSUITED UNSUITED	UNSUITED UNSUITED UNSUITED	POOR POOR POOR	SLIGHT MODERATE: 3 SEVERE: 3	MODERATE: 2 MODERATE: 2,3 SEVERE: 2,3	FAIR GOOD GOOD	GOOD NO DATA AVAIL. FAIR
11	TRACY LYOICK RENSSELAER MINOR	34 18 12 36	SLIGHT SLIGHT SEVERE: 3	SLIGHT SLIGHT SEVERE: 3	SLIGHT SLIGHT SEVERE: 2,3	SEVERE: 7 SEVERE: 7 SEVERE: 3	MOOERATE: 6 MODERATE: 6 SEVERE: 3	FAIR FAIR UNSUITED	UNSUITED UNSUITED UNSUITED	FAIR POOR POOR	SLIGHT SLIGHT SEVERE: 3	SLIGHT SLIGHT SEVERE: 3	FAIR FAIR GOOD	GOOD NO DATA AVAIL. FAIR
12	MIAMI CROSIER BROOKSTON MINOR	26 21 19 34	MODERATE: 1 SEVERE: 3 SEVERE: 3	MODERATE: 1 MODERATE: 3,5 SEVERE: 3	MODERATE: 1,2 SEVERE: 2,3 SEVERE: 2,3	SEVERE: 1 MODERATE: 3 SEVERE: 3	MODERATE: 5,6 SEVERE: 5,6 SEVERE: 3	UNSUITED UNSUITED UNSUITED	UNSUITED UNSUITED UNSUITED	FAIR POOR POOR	MODERATE: 1 MODERATE: 3 SEVERE: 3	SEVERE: 1 MODERATE: 3 SEVERE: 3	GOOD GOOD GOOD	GOOD FAIR FAIR
13	MARTINSVILLE WHITAKER GILFORD MINOR	25 20 15 40	SLIGHT SEVERE: 3 SEVERE: 3	SLIGHT MODERATE: 3 SEVERE: 3	SLIGHT SEVERE: 3 SEVERE: 3	SEVERE: 7 SEVERE: 7 SEVERE: 3,7	MODERATE: 6 SEVERE: 6 SEVERE: 3	UNSUITED UNSUITED FAIR	UNSUITED UNSUITED UNSUITED	FAIR POOR GOOD	SLIGHT MODERATE: 3 SEVERE: 3	SLIGHT MODERATE: 3 SEVERE: 3	GOOD GOOD GOOD	GOOD FAIR POOR

KANKAKEE RIVER BASIN, INDIANA

ESTIMATED SOIL LIMITATIONS OR SUITABILITY FOR SELECTED USES

SOIL ASSOCIATION	SOIL SERIES AND PERCENT OF ASSOCIATION: SOIL SERIES	PCT	DWELLINGS: WITH BASEMENTS	DWELLINGS: WITHOUT BASEMENTS	WASTE DISPOSAL: SEPTIC TANK ABSORPTION FIELDS	WASTE DISPOSAL: SEWAGE LAGOONS	LOCAL ROADS, STREETS, AND PARKING AREAS	SUITABILITY AS A SOURCE OF: SAND	SUITABILITY AS A SOURCE OF: GRAVEL	SUITABILITY AS A SOURCE OF: ROADFILL	RECREATION: CAMP AND PICNIC AREAS	RECREATION: PLAYGROUNDS & ATHLETIC FIELDS	INTENSIVE CROPPING	WOODLAND PRODUCTIVITY
14	WEA WESTLAND PEWAMO MINOR	35 25 18 22	SLIGHT SEVERE: 3 SEVERE: 3	SLIGHT SEVERE: 3 SEVERE: 3	SLIGHT SEVERE: 3 SEVERE: 2,[illegible]	SEVERE: 7 SEVERE: 3,7 SEVERE: 3	MODERATE: 6 SEVERE: 3 SEVERE: 3,5,6	GOOD GOOD UNSUITED	GOOD GOOD UNSUITED	FAIR GOOD POOR	SLIGHT SEVERE: 3 SEVERE: 3	SLIGHT SEVERE: 3 SEVERE: 2,3	GOOD GOOD GOOD	NO DATA AVAIL. FAIR FAIR
15	MUCKS & PEATS MINOR	80 20	SEVERE: 3,5,6	SEVERE: 3,5,6	SEVERE: 3	SEVERE: 3,7	SEVERE: 3,5,6	UNSUITED	UNSUITED	POOR	SEVERE: 3,5,6	SEVERE: 3,5,6	GOOD	POOR
16	MAUMEE RENSSELAER GILFORD MINOR	23 20 17 40	SEVERE: 3 SEVERE: 3 SEVERE: 3	SEVERE: 3 SEVERE: 3 SEVERE: 3	SEVERE: 3 SEVERE: 2,[illegible] SEVERE: 3	SEVERE: [illegible],7 SEVERE: [illegible] SEVERE: [illegible],7	SEVERE: [illegible] SEVERE: 3 SEVERE: 3	FAIR UNSUITED FAIR	UNSUITED UNSUITED UNSUITED	GOOD POOR GOOD	SEVERE: 3 SEVERE: 3 SEVERE: 3	SEVERE: [illegible] SEVERE: [illegible] SEVERE: [illegible]	GOOD GOOD GOOD	POOR FAIR POOR
17	MAUMEE PLAINFIELD MINOR	48 12 40	SEVERE: 3 MODERATE: 1	SEVERE: 3 MODERATE: 1	SEVERE: 3 MODERATE: 1	SEVERE: [illegible],7 SEVERE: 1,7	SEVERE: 3 MODERATE: 1	FAIR GOOD	UNSUITED UNSUITED	GOOD GOOD	SEVERE: 3 MODERATE: 1,6	SEVERE: 3 SEVERE: 1	GOOD POOR	POOR POOR
18	MAUMEE PLAINFIELD MOROCCO MINOR	21 19 11 49	SEVERE: 3 MODERATE: 1 SEVERE: 3	SEVERE: 3 MODERATE: 1 MODERATE: 3	SEVERE: 3 MODERATE: 1 SEVERE: 3	SEVERE: 3,7 SEVERE: 1,7 SEVERE: 7	SEVERE: 3 MODERATE: 1 MODERATE: 3	FAIR GOOD GOOD	UNSUITED UNSUITED UNSUITED	GOOD GOOD GOOD	SEVERE: 3 MODERATE: 1,6 MODERATE: 3	SEVERE: 3 SEVERE: 1 MODERATE: 3	GOOD POOR FAIR	POOR POOR FAIR
19	CONRAD WOOTEN WEISS MINOR	55 21 17 7	SEVERE: 3 SEVERE: 3 SEVERE: 3	SEVERE: 3 SEVERE: 3 MODERATE: 3	SEVERE: 3 SEVERE: 3 SEVERE: 3	SEVERE: 3,7 SEVERE: 3,7 SEVERE: 7	SEVERE: 3 SEVERE: 3 MODERATE: 3	FAIR GOOD GOOD	UNSUITED UNSUITED UNSUITED	GOOD GOOD GOOD	SEVERE: 3 SEVERE: 3 SEVERE: 6	SEVERE: 3 SEVERE: 3 SEVERE: 3,6	FAIR FAIR FAIR	POOR POOR POOR
20	BROOKSTON PARR ODELL MINOR	26 14 10 50	SEVERE: 3 SLIGHT SEVERE: 3	SEVERE: 3 SLIGHT MODERATE: 3	SEVERE: 2,[illegible] MODERATE: [illegible] SEVERE: 3	SEVERE: 3 MODERATE: 7 MODERATE: 7	SEVERE: 3 MODERATE: 5,6 SEVERE: 5,6	UNSUITED UNSUITED UNSUITED	UNSUITED UNSUITED UNSUITED	POOR FAIR POOR	SEVERE: 3 SLIGHT MODERATE: 3	SEVERE: 3 SLIGHT MODERATE: 3	GOOD GOOD GOOD	FAIR NO DATA AVAIL. NO DATA AVAIL.
21	BROOKSTON PARR CORWIN MINOR	33 19 14 34	SEVERE: 3 SLIGHT MODERATE: 3	SEVERE: 3 SLIGHT SLIGHT	SEVERE: 2,3 MODERATE: [illegible] SEVERE: 2	SEVERE: 3 MODERATE: 7 SLIGHT	SEVERE: 3 MODERATE: 5,6 SEVERE: 5,6	UNSUITED UNSUITED UNSUITED	UNSUITED UNSUITED UNSUITED	POOR FAIR POOR	SEVERE: 3 SLIGHT SLIGHT	SEVERE: 3 SLIGHT SLIGHT	GOOD GOOD GOOD	FAIR NO DATA AVAIL. NO DATA AVAIL.
22	CROSIER BROOKSTON MINOR	38 28 34	SEVERE: 3 SEVERE: 3	MODERATE: 3,5 SEVERE: 3	SEVERE: 2,[illegible] SEVERE: 2,[illegible]	MODERATE: [illegible] SEVERE: 3	SEVERE: 5,6 SEVERE: 3	UNSUITED UNSUITED	UNSUITED UNSUITED	POOR POOR	MODERATE: 3 SEVERE: 3	MODERATE: [illegible] SEVERE: 3	GOOD GOOD	FAIR FAIR
23	RENSSELAER DARROCH MINOR	29 17 54	SEVERE: 3 SEVERE: 3	SEVERE: 3 MODERATE: 3	SEVERE: 2,3 SEVERE: 2,3	SEVERE: [illegible] MODERATE: [illegible]	SEVERE: 3 SEVERE: 5,6	UNSUITED UNSUITED	UNSUITED UNSUITED	POOR POOR	SEVERE: 3 MODERATE: 3	SEVERE: 3 MODERATE: 3	GOOD GOOD	FAIR FAIR
24	BROOKSTON ODELL MINOR	47 21 32	SEVERE: 3 SEVERE: 3	SEVERE: 3 MODERATE: 3	SEVERE: 2,3 SEVERE: 3	SEVERE: 3 MODERATE: 7	SEVERE: 3 SEVERE: 5,6	UNSUITED UNSUITED	UNSUITED UNSUITED	POOR POOR	SEVERE: 3 MODERATE: 3	SEVERE: 3 MODERATE: 3	GOOD GOOD	FAIR NO DATA AVAIL.
25	MUSSEY SEBEWA MUCKS MINOR	23 22 16 39	SEVERE: 3 SEVERE: 3 SEVERE: 3,5,6	SEVERE: 3 SEVERE: 3 SEVERE: 3,5,6	SEVERE: 3 SEVERE: 3 SEVERE: 3	SEVERE: 3,7 SEVERE: 3,7 SEVERE: 3,7	SEVERE: 3 SEVERE: 3 SEVERE: 3,5,6	FAIR FAIR UNSUITED	FAIR FAIR UNSUITED	POOR POOR POOR	SEVERE: 3 SEVERE: 3 SEVERE: 3,5,6	SEVERE: 3 SEVERE: 3 SEVERE: 3,5,6	GOOD GOOD GOOD	POOR FAIR POOR

KEY TO PRINCIPAL SOIL LIMITATIONS 1. EXCESSIVE SLOPE FOR INTENDED USE 2. SLOW PERMEABILITY 3. SEASONAL HIGHWATER TABLE 4. FLOOD HAZARD 5. POOR STABILITY 6. ADVERSE SOIL TEXTURE 7. EXCESSIVE PERMEABILITY

USDA-SCS-LINCOLN, NEBR 1976

EXPLANATION OF COLUMNS IN THE TABLE

SOIL ASSOCIATION: THE NUMBERS AND COLORS IN THIS COLUMN CORRESPOND WITH THE NUMBERED SOIL ASSOCIATIONS (GENERAL SOIL AREAS) ON THE GENERAL SOIL MAP OF THE KANKAKEE RIVER BASIN. EACH SOIL ASSOCIATION IS NAMED FOR THE MAJOR SOILS.

SOIL SERIES & PERCENT OF ASSOCIATION: THIS COLUMN SHOWS THE APPROXIMATE PERCENT OF EACH MAJOR SOIL IN EACH ASSOCIATION AND THE TOTAL PERCENT OF ALL THE MINOR SOILS.

DWELLINGS - WITH BASEMENTS: RATINGS ARE FOR UNDISTURBED SOILS THAT ARE EVALUATED FOR SINGLE FAMILY DWELLINGS AND OTHER STRUCTURES WITH SIMILAR FOUNDATION REQUIREMENTS. EXCLUDED ARE BUILDINGS OF MORE THAN THREE STORIES AND OTHER BUILDINGS WITH FOUNDATION LOADS IN EXCESS OF THOSE EQUAL TO THREE STORY DWELLINGS. NO SPECIFIC BEARING STRENGTH IS ESTIMATED OR IMPLIED.

DWELLINGS - WITHOUT BASEMENTS: THE SAME QUALIFICATIONS AS GIVEN ABOVE FOR DWELLINGS – WITH BASEMENTS APPLY HERE EXCEPT THAT SEASONAL HIGH WATER TABLES ARE NOT AS RESTRICTIVE.

WASTE DISPOSAL - SEPTIC TANK ABSORPTION FIELDS: RATINGS ARE FOR SHALLOW, SUBSURFACE TILE ABSORPTION FIELDS AND DO NOT INCLUDE ALTERNATIVE SYSTEMS.

WASTE DISPOSAL - SEWAGE LAGOONS: RATINGS ARE FOR SHALLOW LAKES USED TO HOLD SEWAGE FOR THE TIME REQUIRED FOR BACTERIAL ACTION.

LOCAL ROADS, STREETS, & PARKING AREAS: RATINGS ARE FOR IMPROVED ROADS AND STREETS HAVING SOME KIND OF ALL-WEATHER SURFACING, COMMONLY ASPHALT OR CONCRETE, AND ARE EXPECTED TO CARRY AUTOMOBILE TRAFFIC ALL YEAR.

SUITABILITY AS A SOURCE OF:

SAND - THIS COLUMN PROVIDES GUIDANCE ABOUT WHERE TO LOOK FOR SAND. SOIL RATED "GOOD" CONTAINS A SOURCE OF CLEAN SAND. "FAIR" INDICATES SAND WITH SOME FINE MATERIAL. "POOR" INDICATES SAND WITH FINE MATERIAL COSTLY TO REMOVE. "UNSUITED" INDICATES SAND IS NOT AVAILABLE.

GRAVEL - THE PURPOSE OF THIS COLUMN IS TO PROVIDE GUIDANCE ABOUT WHERE TO LOOK FOR GRAVEL. THE EXPLANATION OF THE RATINGS FOR "SAND" (ABOVE) APPLY ALSO TO "GRAVEL".

ROADFILL - REFERS TO SOIL MATERIAL MOVED FROM ITS ORIGINAL LOCATION AND USED IN ROAD CONSTRUCTION. GENERALLY IT SERVES AS THE SUBGRADE OR FOUNDATION FOR THE ROAD. THE WHOLE SOIL, TO A DEPTH OF 6 FEET, IS GIVEN ONE RATING, ASSUMING IT WILL BE MIXED IN HANDLING.

RECREATION - CAMP AND PICNIC AREAS: RATINGS APPLY TO SOILS TO BE USED INTENSIVELY FOR TENTS AND SMALL CAMP TRAILERS AND THE ACCOMPANYING ACTIVITIES OF OUTDOOR LIVING AND FOR PARK-TYPE PICNIC AREAS.

RECREATION - PLAYGROUNDS, AND ATHLETIC FIELDS: RATINGS APPLY TO SOILS TO BE USED INTENSIVELY FOR PLAYGROUNDS FOR BASEBALL, FOOTBALL, VOLLEYBALL, AND OTHER SIMILAR ORGANIZED GAMES. THESE AREAS ARE SUBJECT TO INTENSIVE FOOT TRAFFIC.

INTENSIVE CROPPING: THE RATINGS ARE BASED ON THE POTENTIAL PRODUCTIVITY OF SOILS TO PRODUCE SUSTAINED CORN YIELDS UNDER HIGH LEVELS OF MANAGEMENT.

WOODLAND PRODUCTIVITY: THE RATINGS ARE BASED ON THE POTENTIAL PRODUCTIVITY OF SOILS FOR THEIR PRIMARY ADAPTED SPECIES.

DATA DEVELOPED BY THE USDA SOIL CONSERVATION SERVICE IN COOPERATION WITH PURDUE UNIVERSITY AGRICULTURAL EXPERIMENT STATION

GENERAL SOIL MAP

THE GENERAL SOIL MAP OF THE KANKAKEE RIVER BASIN IN INDIANA SHOWS 25 MAIN PATTERNS OF SOILS CALLED SOIL ASSOCIATIONS. EACH ASSOCIATION CONTAINS A FEW MAJOR SOILS AND SEVERAL MINOR SOILS, AND IS NAMED FOR THE MAJOR SOILS. THE SOILS IN ONE ASSOCIATION MAY BE IN ANOTHER, BUT IN A DIFFERENT PATTERN.

THE GENERAL SOIL MAP IS USEFUL TO PEOPLE WHO WANT A GENERAL IDEA OF THE SOILS, WHO WANT TO COMPARE DIFFERENT PARTS OF THE RIVER BASIN OR WHO WANT TO KNOW THE LOCATION OF LARGE TRACTS THAT ARE SUITABLE FOR A CERTAIN KIND OF FARM OR NON-FARM LAND USE. SUCH A MAP IS NOT SUITABLE FOR PLANNING THE MANAGEMENT OF A FARM OR FIELD, OR FOR SELECTING THE EXACT LOCATION OF A ROAD, BUILDING, OR SIMILAR STRUCTURE BECAUSE THE SOILS IN ANY ONE ASSOCIATION ORDINARILY DIFFER IN SLOPE, DEPTH, DRAINAGE, OR OTHER CHARACTERISTICS THAT AFFECT MANAGEMENT.

DETAILED SOIL MAPS AND INFORMATION ON SOILS AND SPECIFIC USES ARE AVAILABLE FOR MUCH OF THE AREA ENCOMPASSED BY THE KANKAKEE RIVER BASIN. FOR THIS DETAILED INFORMATION, PLEASE CONTACT THE FIELD OFFICE OF THE SOIL CONSERVATION SERVICE IN THE INDIVIDUAL COUNTIES CONCERNED.

SOIL INTERPRETATIONS

THE INTERPRETIVE TABLE TO THE LEFT, ENTITLED "ESTIMATED SOIL LIMITATIONS OR SUITABILITY FOR SELECTED USES', PROVIDES SOIL INTERPRETATIONS FOR 12 SPECIFIC USES FOR EACH OF THE 25 SOIL ASSOCIATIONS SHOWN ON THE GENERAL SOIL MAP OF THE KANKAKEE RIVER BASIN. THE APPROXIMATE PERCENT OF THE ASSOCIATION OF EACH MAJOR SOIL AND THE TOTAL PERCENT OF ALL OF THE MINOR SOILS IS GIVEN. ESTIMATED LIMITATIONS OR SUITABILITY FOR EACH OF THE NAMED SOILS FOR EACH OF THE 12 USES IS GIVEN IN TERMS OF SLIGHT, MODERATE, OR SEVERE LIMITATIONS OR GOOD, FAIR, POOR, OR UNSUITED SUITABILITY. BESIDE EACH OF THE RATINGS THE LIMITING SOIL PROPERTIES OR FEATURES ARE GIVEN BY LISTING ONE OR MORE NUMBERS. THESE NUMBERS CORRESPOND WITH THOSE LISTED IN THE 'KEY TO PRINCIPAL SOIL LIMITATIONS, AT THE BOTTOM OF THE TABLE. SOILS RATED AS SLIGHT ARE ESTIMATED TO HAVE NO PRINCIPAL SOIL LIMITATIONS AND ARE NOT REFERENCED TO THE KEY.

SOIL LIMITATION CLASSES

SOILS RATED AS "SLIGHT" HAVE FEW OR NO LIMITATIONS FOR THE USE. SOILS RATED AS "MODERATE" HAVE LIMITATIONS WHICH REDUCE TO SOME DEGREE THEIR DESIRABILITY WHEN USED FOR THE PURPOSE BEING CONSIDERED. THEY REQUIRE SOME CORRECTIVE MEASURES. SOILS RATED AS "SEVERE" HAVE UNFAVORABLE SOIL CHARACTERISTICS THAT SEVERELY RESTRICT THEIR USE AND DESIRABILITY FOR THE PURPOSE. A SEVERE RATING DOES NOT MEAN THE SOIL CANNOT BE USED FOR A SPECIFIC USE. IT DOES INDICATE PROBLEMS DURING OR AFTER APPLICATION OF THE USE, UNLESS SPECIAL DESIGN, ENGINEERING, OR OTHER CORRECTIVE MEASURES ARE USED TO OVERCOME THE LIMITATIONS. COSTS ARE USUALLY GREATER THAN ON SOILS RATED SLIGHT OR MODERATE, AND MANY TIMES COSTS ARE PROHIBITIVE.

SOIL SUITABILITY RATING

"GOOD", "FAIR", "POOR", AND "UNSUITED" ARE TERMS USED TO RATE SOILS AS A SOURCE OF SAND, GRAVEL, AND ROADFILL. SOILS RATED AS "GOOD" HAVE QUALITIES SUCH THAT THEY CAN BE CONSIDERED AS A SUITABLE RESOURCE MATERIAL. SOILS RATED "FAIR" HAVE SOME PROBLEMS IN THE MATERIAL THAT MAKE THEM LESS DESIRABLE. SOILS RATED AS "POOR" HAVE PROBLEMS THAT GREATLY LIMIT THEIR SUITABILITY AS A SOURCE. SOILS RATED AS "UNSUITED" ARE PHYSICALLY UNFIT, OR IT IS NOT PRACTICAL TO PROCESS THE MATERIAL.

WHERE USED FOR "INTENSIVE CROPPING", "GOOD" INDICATES SOILS ARE CAPABLE OF PRODUCING SUSTAINED CORN YIELDS OF 110 TO 155 BUSHELS OF CORN PER ACRE UNDER HIGH LEVELS OF MANAGEMENT. "FAIR" INDICATES SOILS THAT WILL PRODUCE 70 TO 110 BUSHELS OF CORN AND "POOR" INDICATES THOSE SOILS THAT WILL PRODUCE LESS THAN 70 BUSHELS OF CORN PER ACRE.

WHERE USED FOR "WOODLAND PRODUCTIVITY", "GOOD" INDICATES SOILS ARE CAPABLE OF PRODUCING GREATER THAN 335 BOARD FEET PER ACRE PER YEAR FOR ADAPTED TREE SPECIES. "FAIR" INDICATES SOILS THAT WILL PRODUCE 260 TO 335 BOARD FEET AND "POOR" INDICATES THOSE SOILS THAT WILL PRODUCE LESS THAN 260 BOARD FEET PER ACRE PER YEAR.

COLORED CIRCLES

THE COLORED CIRCLES SHOW THE PROPORTIONATE EXTENT, OR RELATIVE PERCENTAGE, OF THE LIMITATIONS OR SUITABILITY OF EACH SOIL ASSOCIATION AS A WHOLE FOR A SPECIFIED USE.

- INDICATES SLIGHT OR NO LIMITATIONS OR GOOD SUITABILITY
- INDICATES MODERATE LIMITATIONS OR FAIR SUITABILITY
- INDICATES SEVERE LIMITATIONS OR POOR SUITABILITY
- INDICATES THAT A PART OR ALL OF THE ASSOCIATION IS UNSUITED FOR THAT USE.
- MINOR SOILS, BECAUSE OF THEIR COMPLEXITY, WERE NOT RATED
- NO DATA AVAILABLE

KANKAKEE RIVER BASIN

INDIANA

COMPREHENSIVE BASIN STUDY

SOIL INTERPRETATIONS

U.S. DEPARTMENT OF AGRICULTURE JUNE 1976

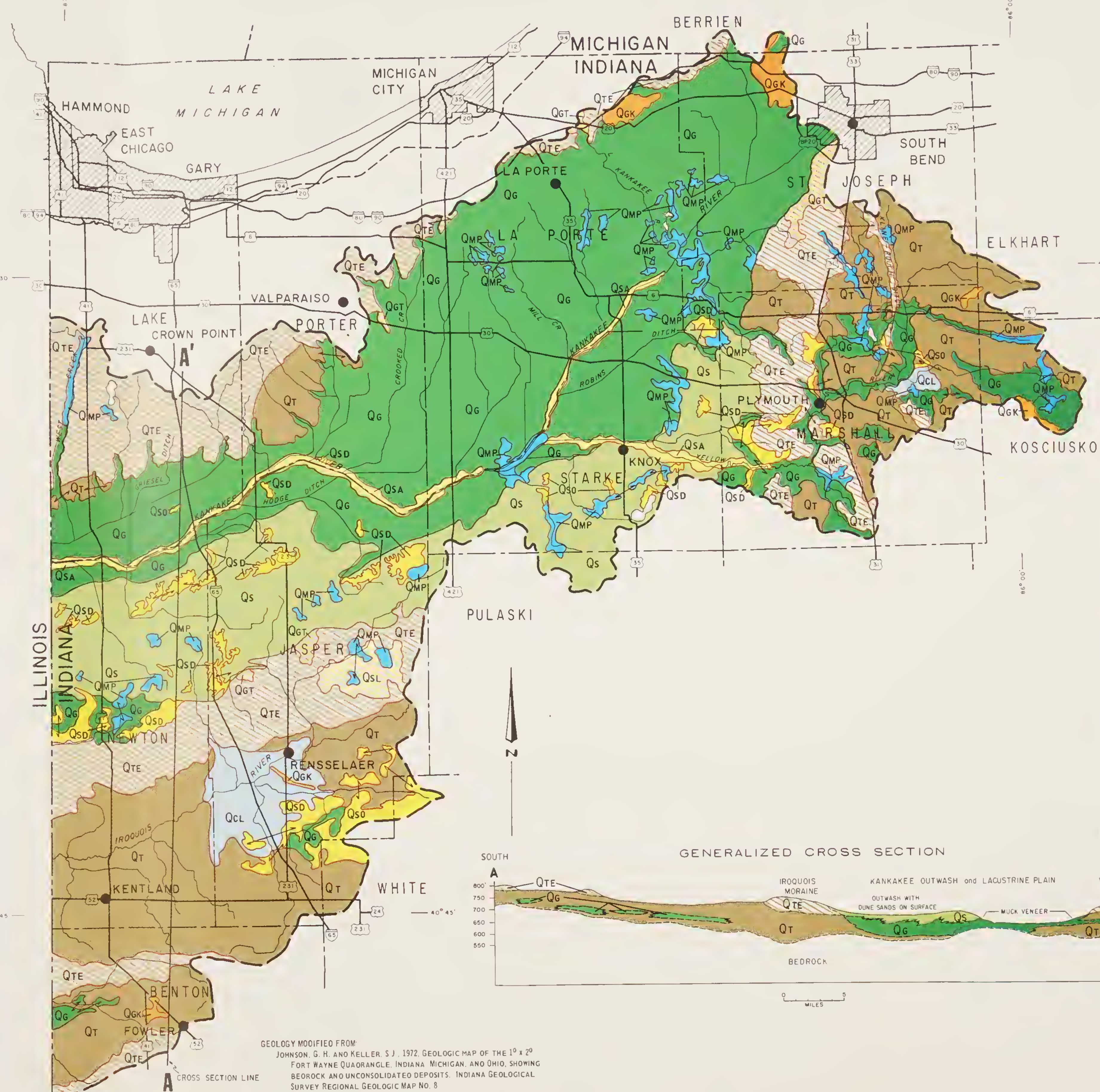
Economic Research Service, Forest Service, and Soil Conservation Service

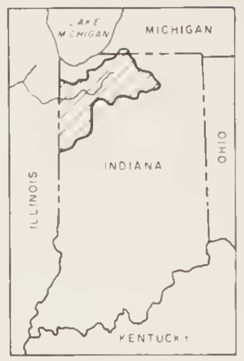
in cooperation with

STATE OF INDIANA – Department of Natural Resources

REV 2-24-76
5,S-34,207

U. S. DEPARTMENT OF AGRICULTURE





BASE LEGEND

- BASIN BOUNDARY
- STATE BOUNDARY
- COUNTY BOUNDARY
- COUNTY SEAT
- TOWN OVER 25,000
- STREAM
- LAKE
- INTERSTATE HIGHWAY
- U.S. HIGHWAY

EXPLANATION

QUATERNARY SYSTEM

Qg / Qs — OUTWASH-PLAIN AND VALLEY-TRAIN DEPOSITS WITH SOME AREAS OF LACUSTRINE DEPOSITS AND BEACH SANDS. Qg, PRIMARILY GRAVEL, SAND, AND SILT OVERLAIN IN PLACES BY THIN DEPOSITS OF MUCK, PEAT, CLAY, SILT, OR FINE SAND (MOSTLY OUTWASH-PLAIN AND VALLEY-TRAIN DEPOSITS); Qs, OUTWASH, LACUSTRINE, AND BEACH SANDS THAT HAVE BEEN REWORKED BY WIND ACTION. DIFFERS FROM Qg BY SLIGHTLY GREATER ELEVATION AND RELIEF, SLIGHTLY LOWER WATER TABLE AND GREATER FREQUENCY OF SAND DUNES.

Qt / Qte — GLACIAL TILL WITH SOME ICE-CONTACT STRATIFIED DRIFT. MAINLY GROUND-MORAINE (Qt) DEPOSITS WHICH ARE TOPOGRAPHICALLY LOWER THAN THE MORE HUMMOCKY OR RIDGELIKE END-MORAINE (Qte) DEPOSITS.

Qsa — ALLUVIUM - RECENT STREAM DEPOSITS OF SILT, SAND, AND GRAVEL.

Qmp — PALUDAL (MARSH) AND LACUSTRINE (LAKE) DEPOSITS - MUCK, PEAT, AND MARL (NUMEROUS SMALL AREAS NOT SHOWN).

Qsd / Qsl — EOLIAN AND LACUSTRINE SANDS - Qsd, DUNE SANDS AND SOME SILTS (NUMEROUS GENERALLY SMALLER DUNE AREAS NOT SHOWN); Qsl, LACUSTRINE SANDS.

Qcl — LACUSTRINE CLAY AND SILT.

Qgk / Qgt — ICE-CONTACT STRATIFIED GLACIAL DRIFT - Qgk, GRAVEL, SAND, AND SOME SILT IN KAMES AND KAME MORAINES; Qgt, UNDIFFERENTIATED DRIFT OF SAND, GRAVEL, AND TILL IN END MORAINES.

NOTE: THE MAP UNITS AND BOUNDARIES SHOWN HEREON HAVE BEEN GENERALIZED TO BETTER CONFORM TO THE PURPOSES AND SCALE OF THE MAP.

GENERALIZED CROSS SECTION

GEOLOGY MODIFIED FROM:

JOHNSON, G. H. AND KELLER, S. J., 1972, GEOLOGIC MAP OF THE 1° x 2° FORT WAYNE QUADRANGLE, INDIANA, MICHIGAN, AND OHIO, SHOWING BEDROCK AND UNCONSOLIDATED DEPOSITS. INDIANA GEOLOGICAL SURVEY REGIONAL GEOLOGIC MAP NO. 8

SCHNEIDER, A.F., AND KELLER, S. J., 1970, GEOLOGIC MAP OF THE 1° x 2° CHICAGO QUADRANGLE, INDIANA, ILLINOIS, AND MICHIGAN, SHOWING BEDROCK AND UNCONSOLIDATED DEPOSITS. INDIANA GEOLOGICAL SURVEY REGIONAL GEOLOGIC MAP NO. 4

WAYNE, W. J., JOHNSON, G.H., AND KELLER, S. J., 1966, GEOLOGIC MAP OF THE 1° x 2° DANVILLE QUADRANGLE, INDIANA AND ILLINOIS, SHOWING BEDROCK AND UNCONSOLIDATED DEPOSITS. INDIANA GEOLOGICAL SURVEY REGIONAL GEOLOGIC MAP NO. 2.

SCALE 1/650,000

SCALE 5 0 5 10 15 MILES

TRANSVERSE MERCATOR PROJECTION

SOURCE
SCS DRAWING NUMBER 5,S-30,636
AND INFORMATION FROM FIELD TECHNICIANS

KANKAKEE RIVER BASIN

INDIANA

COMPREHENSIVE BASIN STUDY

GENERALIZED SURFICIAL GEOLOGIC MAP

U.S. DEPARTMENT OF AGRICULTURE JUNE 1976

Economic Research Service, Forest Service, and Soil Conservation Service

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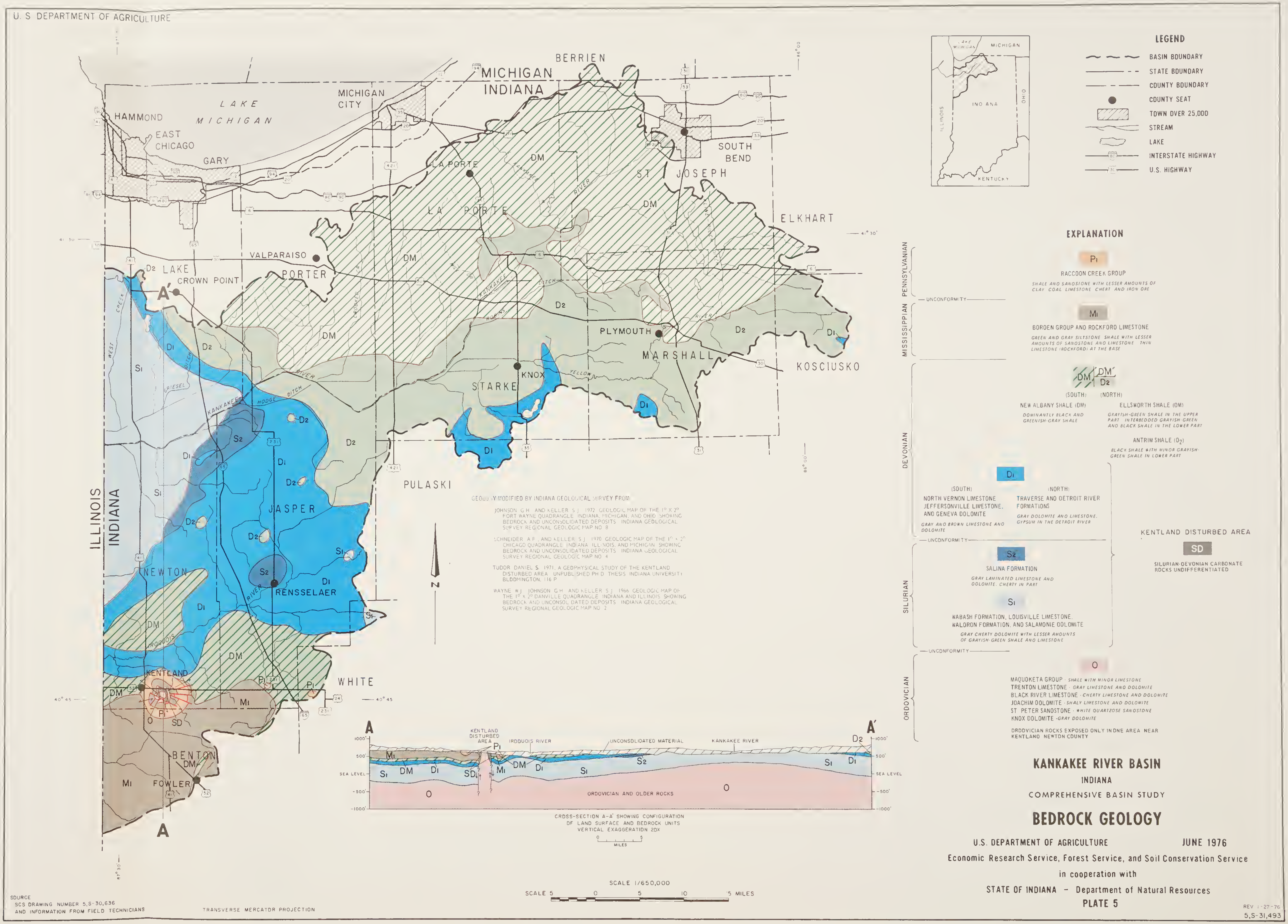
STATE OF INDIANA – Department of Natural Resources

PLATE 4

REV 2-27-76
5,S-30,834



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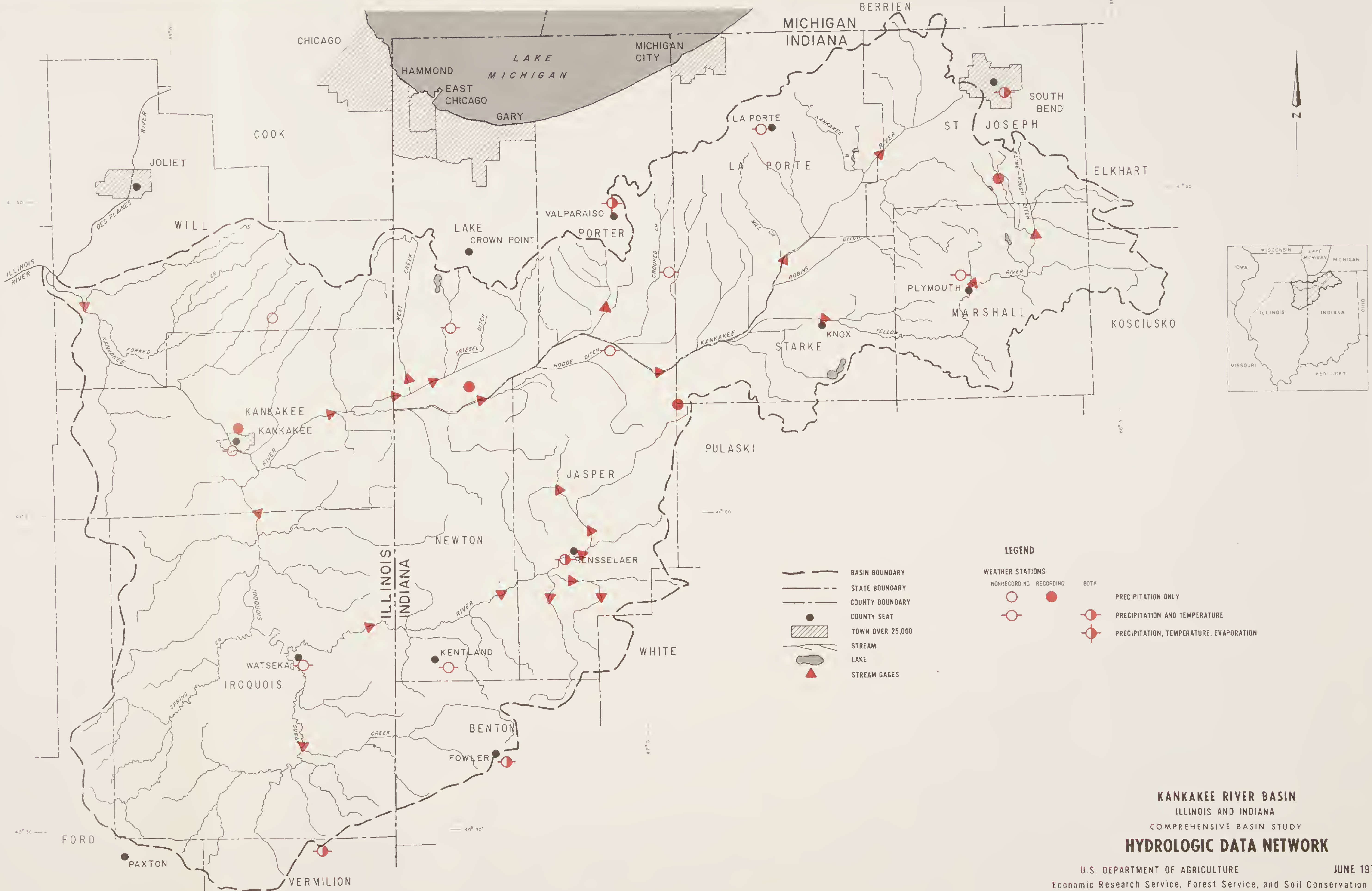

SOURCE
SCS DRAWING 5,S-28,860 AND INFORMATION
FROM FIELD TECHNICIANS

TRANSVERSE MERCATOR PROJECTION

KANKAKEE RIVER BASIN
ILLINOIS AND INDIANA
COMPREHENSIVE BASIN STUDY

HYDROLOGIC DATA NETWORK

U.S. DEPARTMENT OF AGRICULTURE JUNE 1976
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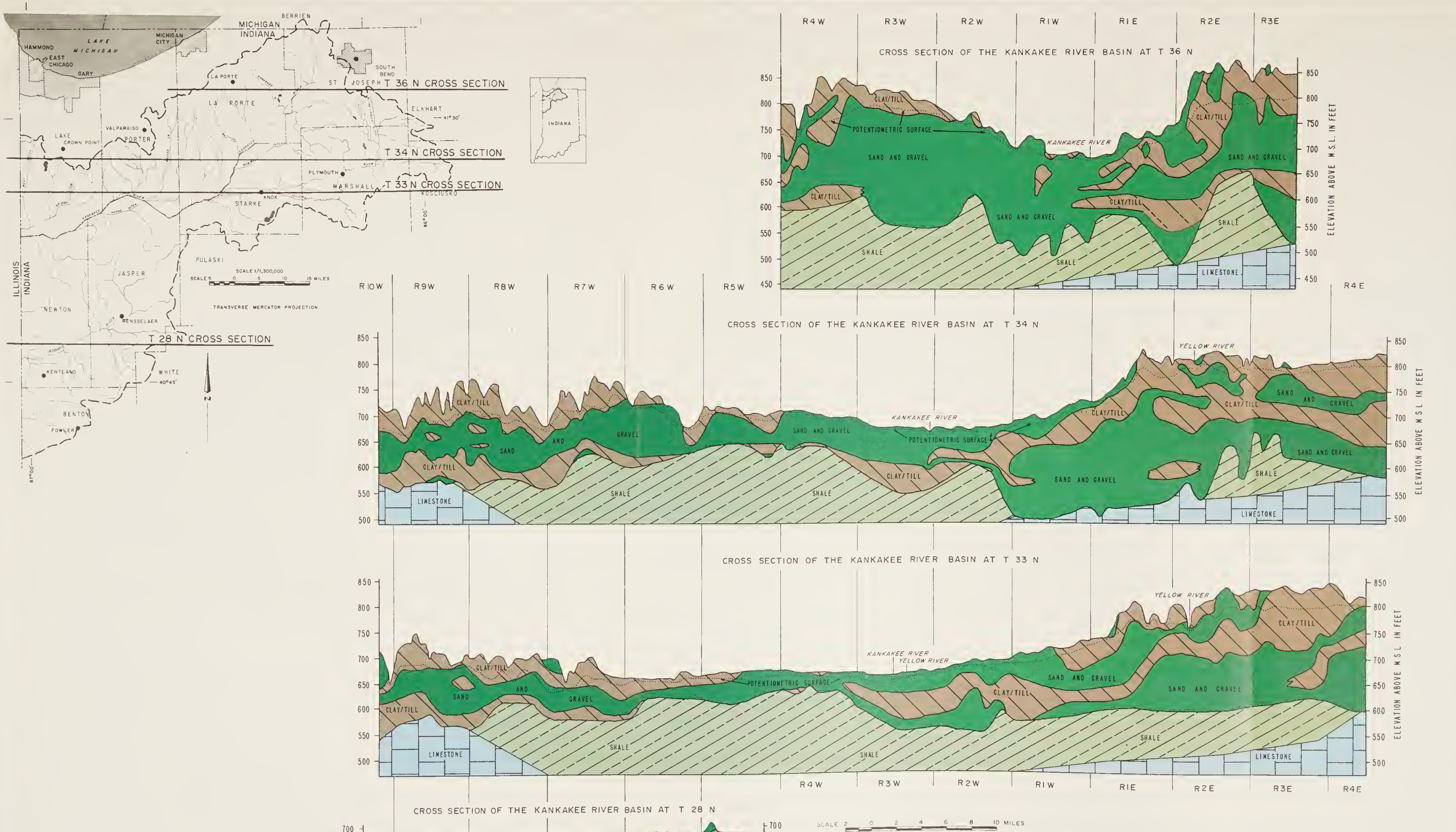
PLATE 6

REV 1-27-76
5,S-32,114



KANKAKEE RIVER BASIN

INDIANA

COMPREHENSIVE BASIN STUDY

GEOLOGIC CROSS SECTIONS

U.S. DEPARTMENT OF AGRICULTURE JUNE 1976

Economic Research Service, Forest Service, and Soil Conservation Service

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STATE OF INDIANA – Department of Natural Resources

PLATE 7

REV 2-27-76

5,S-32,108

SOURCE:
SCS DRAWING NUMBER 5,S-30,636 WITH INFORMATION FROM FIELD TECHNICIANS AND FROM DATA COMPILATIONS AND INTERPRETATIONS BY GARY M. BRAZO, DIVISION OF WATER, DEPARTMENT OF NATURAL RESOURCES, STATE OF INDIANA.

USDA-SCS-LINCOLN NB 1976

EXPLANATION

WATER WELLS IN THIS REGION ARE COMPLETED PRIMARILY IN LIMESTONE DOLOMITE AQUIFERS THAT ARE OVERLAIN BY GLACIAL TILL AND OCCASIONAL SHALE BEDS OF VARYING THICKNESS. THIS BEDROCK AQUIFER IS THE MAIN SOURCE OF GROUND WATER FOR THIS AREA. DEPTHS OF WELLS RANGE FROM 25 TO 200 FEET WITH YIELDS TO WELLS RANGING FROM LESS THAN 5 TO 25 GALLONS PER MINUTE (GPM). THE SHALE IS OCCASIONALLY USED, BUT IS A LIMITED SOURCE OF WATER. POTENTIAL FOR GROUND WATER DEVELOPMENT: POOR TO FAIR.

WATER WELLS IN THESE REGIONS ARE COMPLETED IN SAND AND GRAVEL AQUIFERS THAT ARE INTERMIXED WITH THE GLACIAL TILL. THESE SAND AND GRAVEL AQUIFERS ARE THE PRIME SOURCE OF GROUND WATER FOR THESE REGIONS. DEPTHS OF WELLS VARY FROM 25 TO 125 FEET. YIELDS TO WELLS ARE IN THE 10 TO 75 GPM RANGE. POTENTIAL FOR GROUND WATER DEVELOPMENT: FAIR TO GOOD.

WATER WELLS IN THIS AREA ARE COMPLETED IN SAND AND GRAVEL AQUIFERS THAT ARE INTERMIXED WITH THE GLACIAL TILL. THESE AQUIFERS ARE THE PRIME SOURCE OF GROUND WATER FOR THIS AREA. WELL DEPTHS VARY FROM 25 TO 50 FEET. YIELDS TO WELLS RANGE FROM 5 TO 50 GPM. POTENTIAL FOR GROUND WATER DEVELOPMENT: FAIR TO GOOD.

WATER WELLS IN THIS AREA CAN BE COMPLETED IN SAND AND GRAVEL AQUIFERS THAT ARE, GEOLOGICALLY AND HYDROLOGICALLY, SIMILAR TO THOSE DESCRIBED IMMEDIATELY ABOVE. IN ADDITION, A LIMESTONE DOLOMITE BEDROCK AQUIFER WHICH UNDERLIES THE GLACIAL AQUIFERS IS AVAILABLE AS A SOURCE OF GROUND WATER. DEPTHS OF WATER WELLS IN THIS LIMESTONE DOLOMITE AQUIFER VARY FROM 50 TO 100 FEET AND YIELDS TO WELLS ARE IN THE 5 TO 50 GPM RANGE. SHALE BEDROCK OCCURS LOCALLY OVER THE LIMESTONE DOLOMITE AQUIFER AND WATER WELLS COMPLETED IN IT ARE LIMITED PRODUCERS. POTENTIAL FOR GROUND WATER DEVELOPMENT: FAIR TO GOOD.

WATER WELLS IN THIS REGION ARE COMPLETED IN A GLACIAL SAND AQUIFER WHICH IS ABOUT 30 FEET THICK IN THE SOUTH AND WHICH THICKENS TOWARDS THE NORTH. THIS SAND AQUIFER IS THE BEGINNING, AND SOUTHERNMOST PORTION, OF THE KANKAKEE AQUIFER OF THE KANKAKEE RIVER BASIN. DEPTHS OF WELLS VARY FROM 25 TO 125 FEET. YIELDS TO WELLS CAN BE FROM 250 TO 500 GPM. POTENTIAL FOR GROUND WATER DEVELOPMENTS: GOOD TO EXCELLENT.

WATER WELLS IN THIS AREA CAN BE COMPLETED IN THE KANKAKEE AQUIFER THAT IS DESCRIBED IMMEDIATELY ABOVE. IN ADDITION, A LIMESTONE DOLOMITE BEDROCK AQUIFER WHICH UNDERLIES THE GLACIAL AQUIFER IS AVAILABLE AS A SOURCE OF GROUND WATER. DEPTHS OF WATER WELLS IN THIS LIMESTONE DOLOMITE AQUIFER VARY FROM 50 TO 200 FEET AND YIELDS TO WELLS ARE IN THE 25 TO 100 GPM RANGE. HIGHER YIELDS HAVE BEEN REPORTED ON A LOCAL BASIS. SHALE BEDROCK OCCURS, LOCALLY, OVER THE LIMESTONE DOLOMITE AQUIFER; HOWEVER, WATER WELLS ARE SELDOM COMPLETED IN THIS SHALE AND, WHEN COMPLETED, ARE LIMITED PRODUCERS. POTENTIAL FOR GROUND WATER DEVELOPMENT: GOOD.

WATER WELLS IN THIS REGION ARE COMPLETED IN SAND AND GRAVEL AQUIFERS WHICH ARE A CONTINUATION OF THE KANKAKEE AQUIFER. WELL DEPTHS VARY FROM 25 TO 125 FEET. YIELDS TO WELLS CAN BE IN THE 250 TO 750 GPM RANGE. THE BEDROCK IS NOT USED AS A GROUND WATER SOURCE. POTENTIAL FOR GROUND WATER DEVELOPMENT. EXCELLENT

WATER WELLS IN THIS REGION ARE COMPLETED IN SANDS AND GRAVELS WHICH ARE PART OF THE KANKAKEE AQUIFER. DEPTHS OF WELLS ARE FROM 40 TO 150 FEET. YIELDS TO WELLS CAN BE IN THE RANGE OF 500 TO 1000 GPM. THE BEDROCK IS NOT USED AS A SOURCE OF GROUND WATER. POTENTIAL FOR GROUND WATER DEVELOPMENT: EXCELLENT.

WATER WELLS IN THIS REGION ARE COMPLETED IN SAND AND GRAVEL AQUIFERS, WHICH ARE THE LAST SEGMENT OF THE KANKAKEE AQUIFER IN THE KANKAKEE RIVER BASIN. WELL DEPTHS VARY FROM 50 TO 200 FEET. YIELDS TO WELLS CAN BE IN THE 1000 TO 2000 GPM RANGE. THE BEDROCK IS NOT USED AS A GROUND WATER SOURCE. POTENTIAL FOR GROUND WATER DEVELOPMENT: EXCELLENT

WATER WELLS IN THIS REGION ARE COMPLETED IN SAND AND GRAVEL AQUIFERS WHICH ARE INTERMIXED WITH GLACIAL TILL AND ARE NOT PART OF THE KANKAKEE AQUIFER. WELL DEPTHS RANGE FROM 50 TO 200 FEET. YIELDS TO WELLS CAN BE IN THE 1000 TO 1500 GPM RANGE. THE BEDROCK IS NOT USED AS A SOURCE OF GROUND WATER. POTENTIAL FOR GROUND WATER DEVELOPMENT: EXCELLENT.

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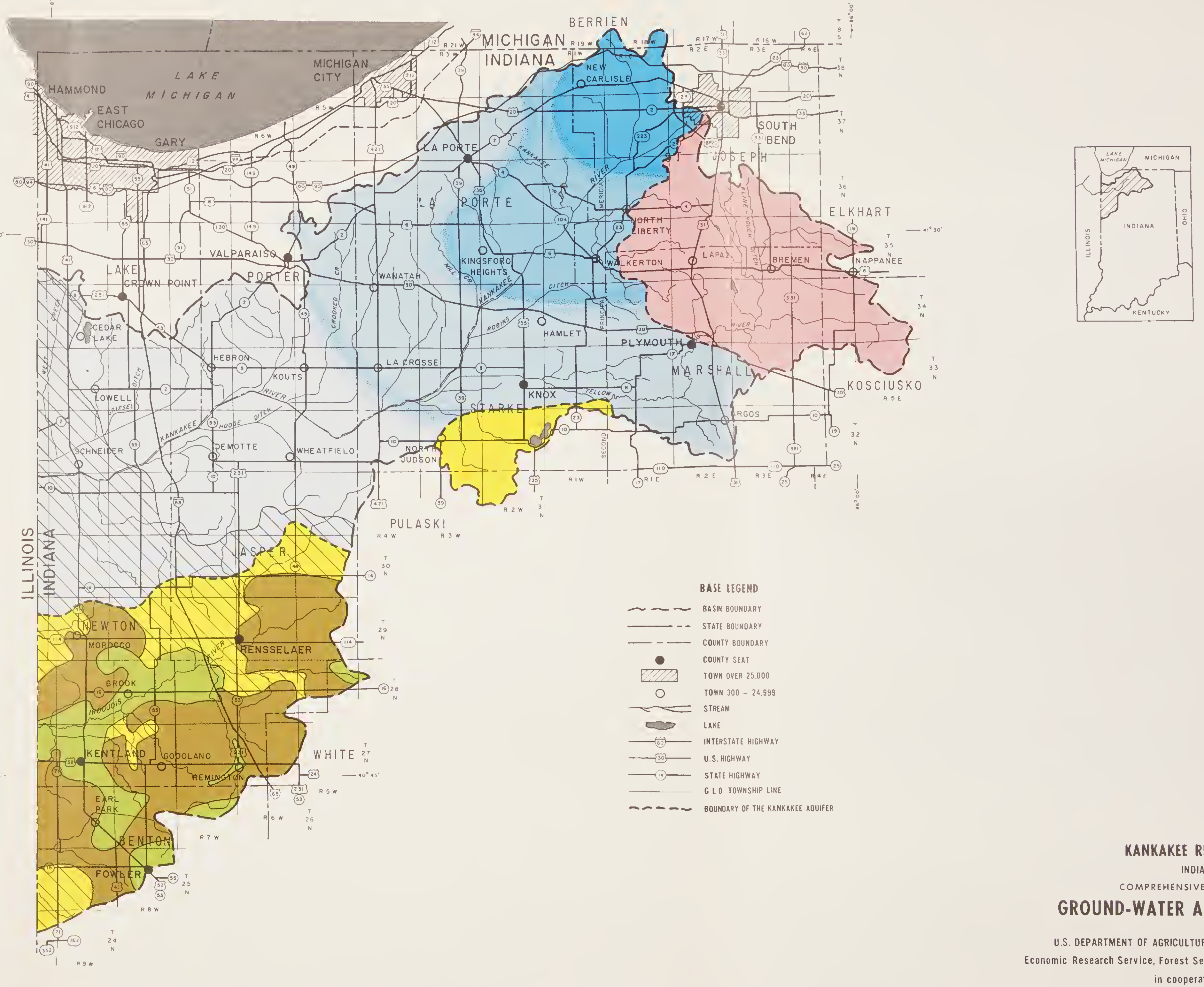


SOURCE:
SCS DRAWING 5,S-30,636, AND DATA COMPILATION AND INTERPRETATIONS BY GARY M. BRAZO, DIVISION OF WATER, DEPARTMENT OF NATURAL RESOURCES, STATE OF INDIANA

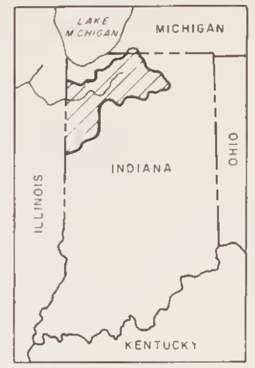
KANKAKEE RIVER BASIN
INDIANA
COMPREHENSIVE BASIN STUDY

GROUND-WATER AVAILABILITY MAP

U.S. DEPARTMENT OF AGRICULTURE JUNE 1976
Economic Research Service, Forest Service, and Soil Conservation Service
in cooperation with
STATE OF INDIANA – Department of Natural Resources
PLATE 8

REV. 2-27-76
5,R-31,664

U. S. DEPARTMENT OF AGRICULTURE



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SOURCE:
SCS DRAWING 5,S-30,636; AND DATA COMPILATION AND INTERPRETATIONS BY GARY M BRAZO, DIVISION OF WATER, DEPARTMENT OF NATURAL RESOURCES, STATE OF INDIANA.

TRANSVERSE MERCATOR PROJECTION

SCALE 1/650,000

SCALE 5 0 5 10 15 MILES

KANKAKEE RIVER BASIN

INDIANA

COMPREHENSIVE BASIN STUDY

BEDROCK TOPOGRAPHY MAP

U.S. DEPARTMENT OF AGRICULTURE JUNE 1976

Economic Research Service, Forest Service, and Soil Conservation Service

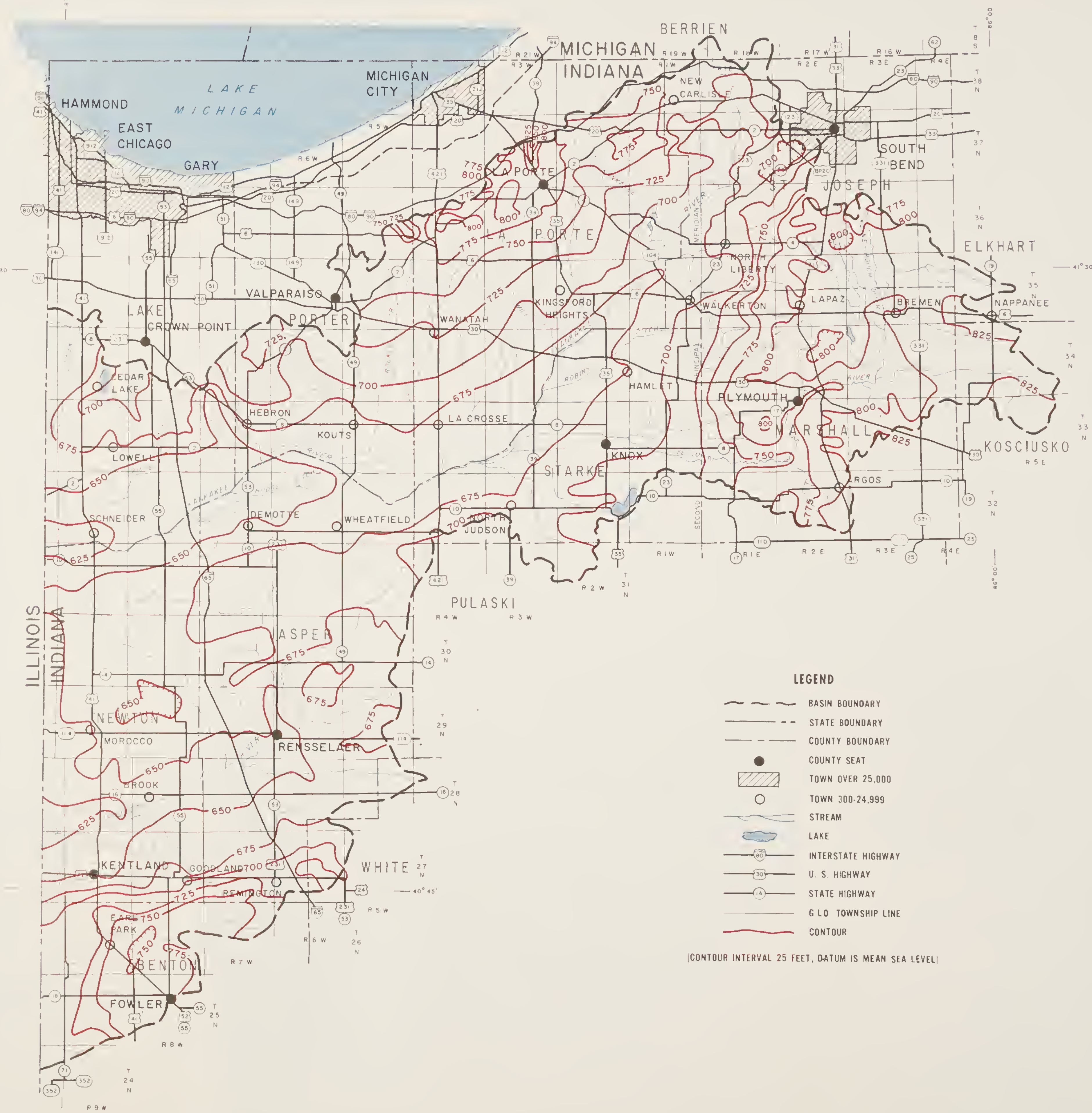
in cooperation with

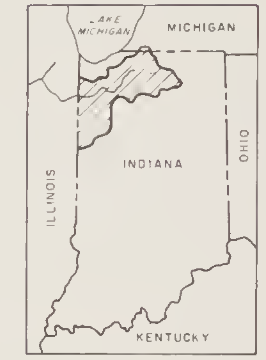
STATE OF INDIANA – Department of Natural Resources

PLATE 9

5,S-31,662

U. S DEPARTMENT OF AGRICULTURE





SCALE 1/650,000

SCALE 5 0 5 10 15 MILES

TRANSVERSE MERCATOR PROJECTION

SOURCE
SCS DRAWING 5,S-30,636; AND DATA COMPILATION AND INTERPRETATIONS BY GARY M. BRAZO, DIVISION OF WATER, DEPARTMENT OF NATURAL RESOURCES, STATE OF INDIANA

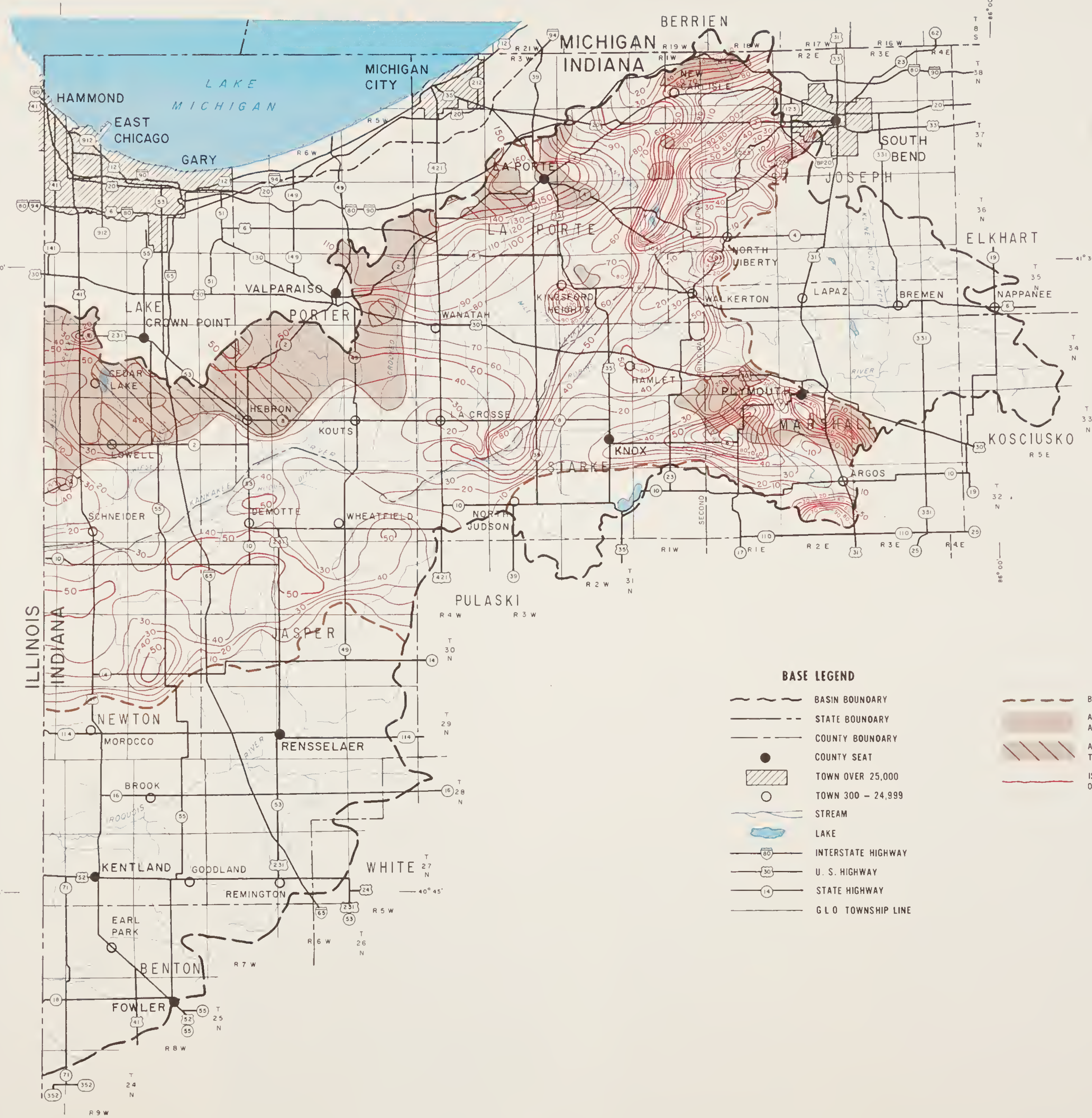
KANKAKEE RIVER BASIN
INDIANA
COMPREHENSIVE BASIN STUDY

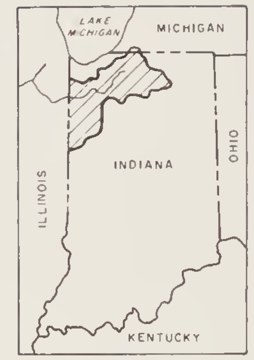
GROUND WATER LEVEL MAP
(POTENTIOMETRIC SURFACE)

U.S. DEPARTMENT OF AGRICULTURE JUNE 1976
Economic Research Service, Forest Service, and Soil Conservation Service
in cooperation with
STATE OF INDIANA – Department of Natural Resources
PLATE 10

REV 1-27-76
5,S-31,661

U. S. DEPARTMENT OF AGRICULTURE





N

BASE LEGEND

- BASIN BOUNDARY
- STATE BOUNDARY
- COUNTY BOUNDARY
- COUNTY SEAT
- TOWN OVER 25,000
- TOWN 300 – 24,999
- STREAM
- LAKE
- INTERSTATE HIGHWAY
- U. S. HIGHWAY
- STATE HIGHWAY
- G L O TOWNSHIP LINE

EXPLANATION

- BOUNDARY OF KANKAKEE AQUIFER SYSTEM
- AREAL EXTENT OF GLACIAL TILLS OVERLYING KANKAKEE AQUIFER SYSTEM
- AREAS OF ARTESIAN WATER CONDITIONS WITHIN THE GLACIAL TILL - KANKAKEE AQUIFER COMPLEX
- ISOPACH CONTOUR (SHOWS THICKNESS OF THE SATURATED ZONE OF THE KANKAKEE AQUIFER CONTOUR INTERVAL 10 FEET).

KANKAKEE RIVER BASIN

INDIANA

COMPREHENSIVE BASIN STUDY

SATURATED THICKNESS OF THE KANKAKEE AQUIFER

U.S. DEPARTMENT OF AGRICULTURE JUNE 1976

Economic Research Service, Forest Service, and Soil Conservation Service

in cooperation with

STATE OF INDIANA – Department of Natural Resources

PLATE 11

REV 2-27-76

5,S-31,663

SCALE 1/650,000

SCALE 5 0 5 10 15 MILES

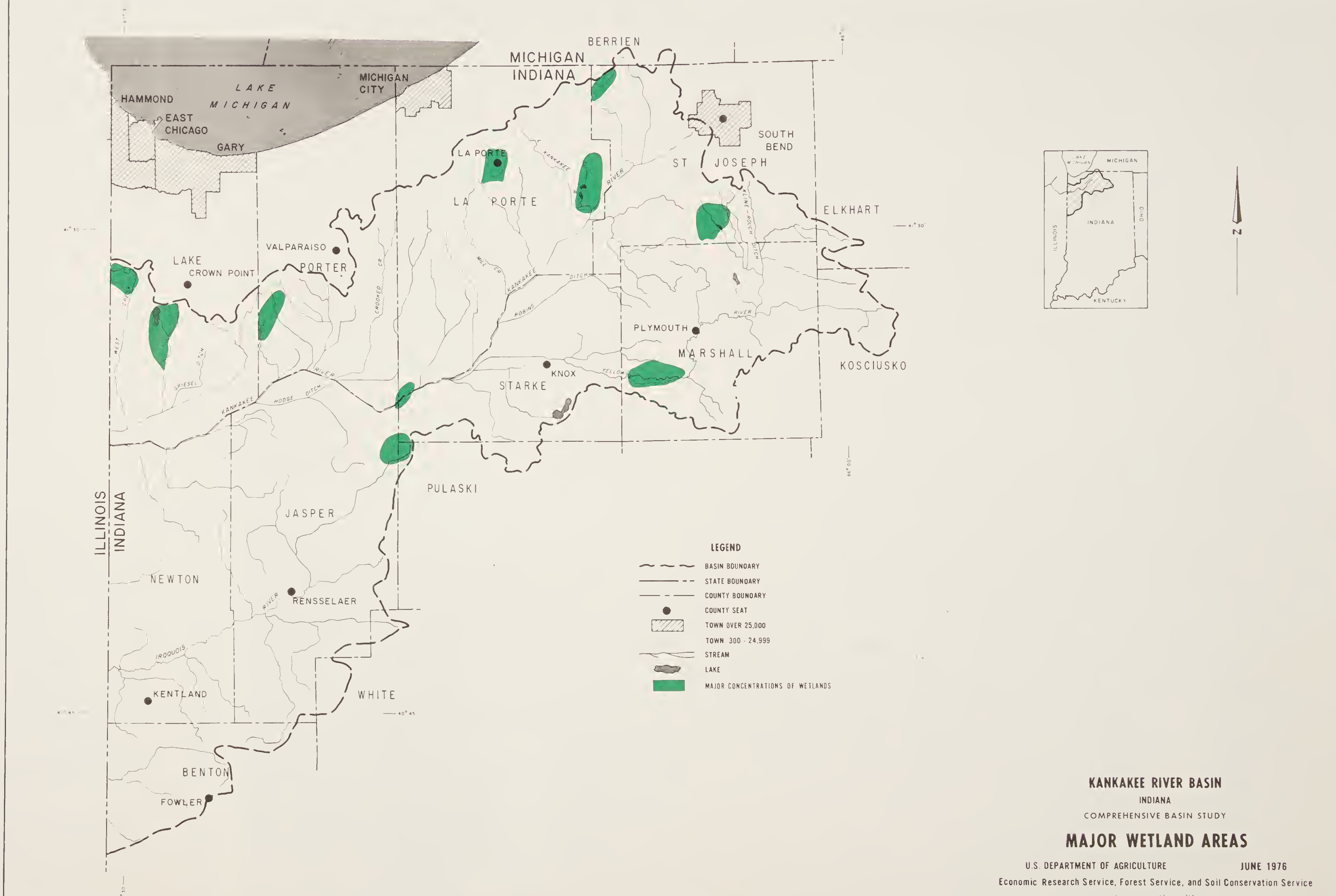
TRANSVERSE MERCATOR PROJECTION

SOURCE

SCS DRAWING 5,S-30,636; AND DATA COMPILATION AND INTERPRETATIONS BY GARY M. BRAZO, DIVISION OF WATER, DEPARTMENT OF NATURAL RESOURCES, STATE OF INDIANA

USDA-SCS-LINCOLN, NEBR. 1976

U S DEPARTMENT OF AGRICULTURE



SOURCE:
SCS DRAWING NO. 5,S-28,860 AND
1972 WETLAND SURVEY BY DIVISION OF FISH
AND WILDLIFE, DEPT. OF NATURAL RESOURCES
STATE OF INDIANA TRANVERSE MERCATOR PROJECTION
USDA SCS LINCOLN NEBR 1976

KANKAKEE RIVER BASIN

INDIANA

COMPREHENSIVE BASIN STUDY

MAJOR WETLAND AREAS

U.S. DEPARTMENT OF AGRICULTURE JUNE 1976

Economic Research Service, Forest Service, and Soil Conservation Service

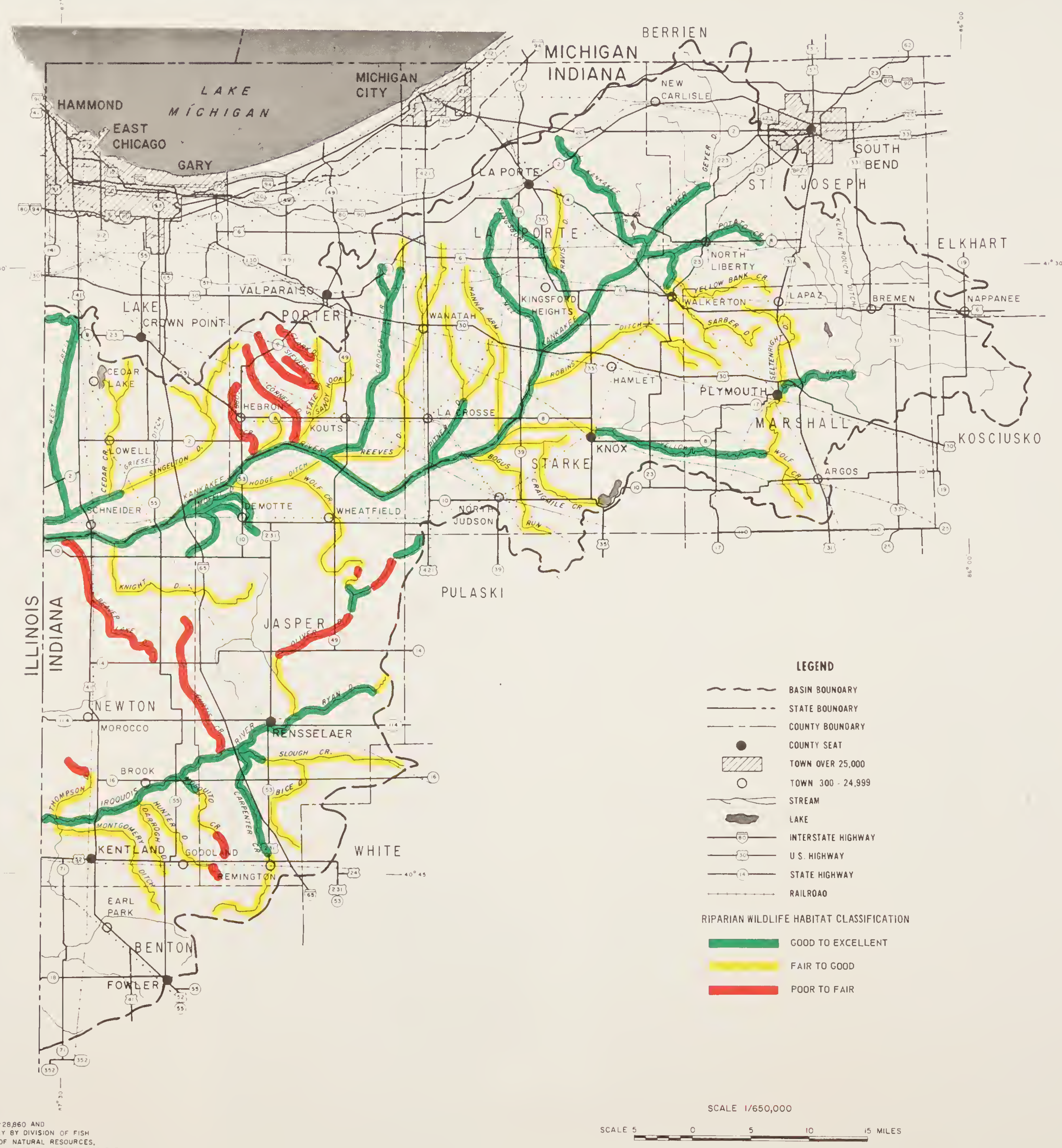
in cooperation with

STATE OF INDIANA – Department of Natural Resources

PLATE 12

REV 2-27-76
5,P-34,325.2

U. S. DEPARTMENT OF AGRICULTURE



SOURCE
SCS DRAWING NO 5,S-28,860 AND
1972 HABITAT SURVEY BY DIVISION OF FISH
AND WILDLIFE, DEPT. OF NATURAL RESOURCES,
STATE OF INDIANA. TRANSVERSE MERCATOR PROJECTION
USDA SCS-LINCOLN NEBR 1976

KANKAKEE RIVER BASIN

INDIANA

COMPREHENSIVE BASIN STUDY

RIPARIAN WILDLIFE HABITAT

U.S. DEPARTMENT OF AGRICULTURE JUNE 1976

Economic Research Service, Forest Service, and Soil Conservation Service

in cooperation with

STATE OF INDIANA – Department of Natural Resources

PLATE 13

REV 2-27-76
5,P-34,325

U. S. DEPARTMENT OF AGRICULTURE

KANKAKEE RIVER BASIN

INDIANA

COMPREHENSIVE BASIN STUDY

STREAM FISHERIES HABITAT

U.S. DEPARTMENT OF AGRICULTURE JUNE 1976

Economic Research Service, Forest Service, and Soil Conservation Service

in cooperation with

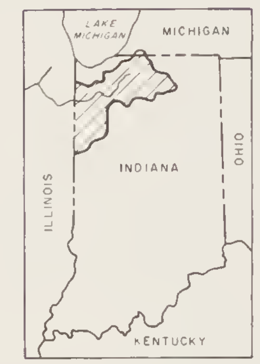
STATE OF INDIANA – Department of Natural Resources

PLATE 14

REV 2-27-76
5,P-34,325 I

SOURCE.
SCS DRAWING NO 5,S-28,860 AND
1972 HABITAT SURVEY BY DIVISION OF FISH
AND WILDLIFE, DEPT. OF NATURAL RESOURCES,
STATE OF INDIANA TRANSVERSE MERCATOR PROJECTION
USDA SCS-LINCOLN NEBR 1976

U. S. DEPARTMENT OF AGRICULTURE



N

RECREATION AREAS

1. WILLOW SLOUGH STATE FISH AND WILDLIFE AREA
2. LA SALLE STATE FISH AND WILDLIFE AREA
3. JASPER-PULASKI STATE FISH AND WILDLIFE AREA
4. KANKAKEE STATE FISH AND WILDLIFE AREA
5. BASS LAKE STATE BEACH
6. KINGSBURY STATE FISH AND WILOLIFE AREA
7. LAKE OF THE WOODS PUBLIC BEACH
8. POTATO CREEK RECREATION AREA

HISTORIC AREAS

1. BAUM'S BRIDGE
2. MONUMENT TO CHIEF MENOMINEE

SCENIC AREAS

1. KANKAKEE RIVER
2. LITTLE KANKAKEE RIVER
3. FISH LAKES
4. YELLOW RIVER

NATURAL AREAS

1. MYSTERY MOUNDS
2. BEAVER LAKE NATURE PRESERVE
3. TALL GRASS SAND PRAIRIE
4. KENTLAND STRUCTURAL ANOMALY
5. PRAIRIE BORDER
6. BIRO MARSH
7. HASKELL'S PRAIRIE
8. SHOEMAKER BOG
9. MILL CREEK FEN
10. KOONTZ LAKE MARSH
11. BENOIX GIFT PARK WOODS NATURE PRESERVE
12. NEW OAK ROAD BOGS

ACRES OF CLASSIFIED FOREST

JASPER COUNTY	175 ACRES
LAKE COUNTY	150 ACRES
LA PORTE COUNTY	3,100 ACRES
MARSHALL COUNTY	2,280 ACRES
NEWTON COUNTY	25 ACRES
PORTER COUNTY	100 ACRES
STARKE COUNTY	1,350 ACRES
ST JOSEPH COUNTY	3,000 ACRES
BASIN TOTAL	10,180 ACRES

NUMBER OF CERTIFIED ARCHEOLOGICAL SITES PER COUNTY

JASPER	12
LAKE	141
LA PORTE	17
MARSHALL	317
NEWTON	73
PORTER	121
STARKE	88
ST JOSEPH	24
WHITE	1
	794

LEGEND

- BASIN BOUNDARY
- STATE BOUNDARY
- COUNTY BOUNDARY
- COUNTY SEAT
- TOWN OVER 25,000
- STREAM
- LAKE
- INTERSTATE HIGHWAY
- U.S. HIGHWAY
- STATE HIGHWAY
- RECREATION AREA
- HISTORIC AREA
- SCENIC AREA
- NATURAL AREA

KANKAKEE RIVER BASIN

INDIANA

COMPREHENSIVE BASIN STUDY

ENVIRONMENTAL AND RECREATION MAP

U.S. DEPARTMENT OF AGRICULTURE JUNE 1976

Economic Research Service, Forest Service, and Soil Conservation Service

in cooperation with

STATE OF INDIANA – Department of Natural Resources

PLATE 15

SCALE 1/650,000

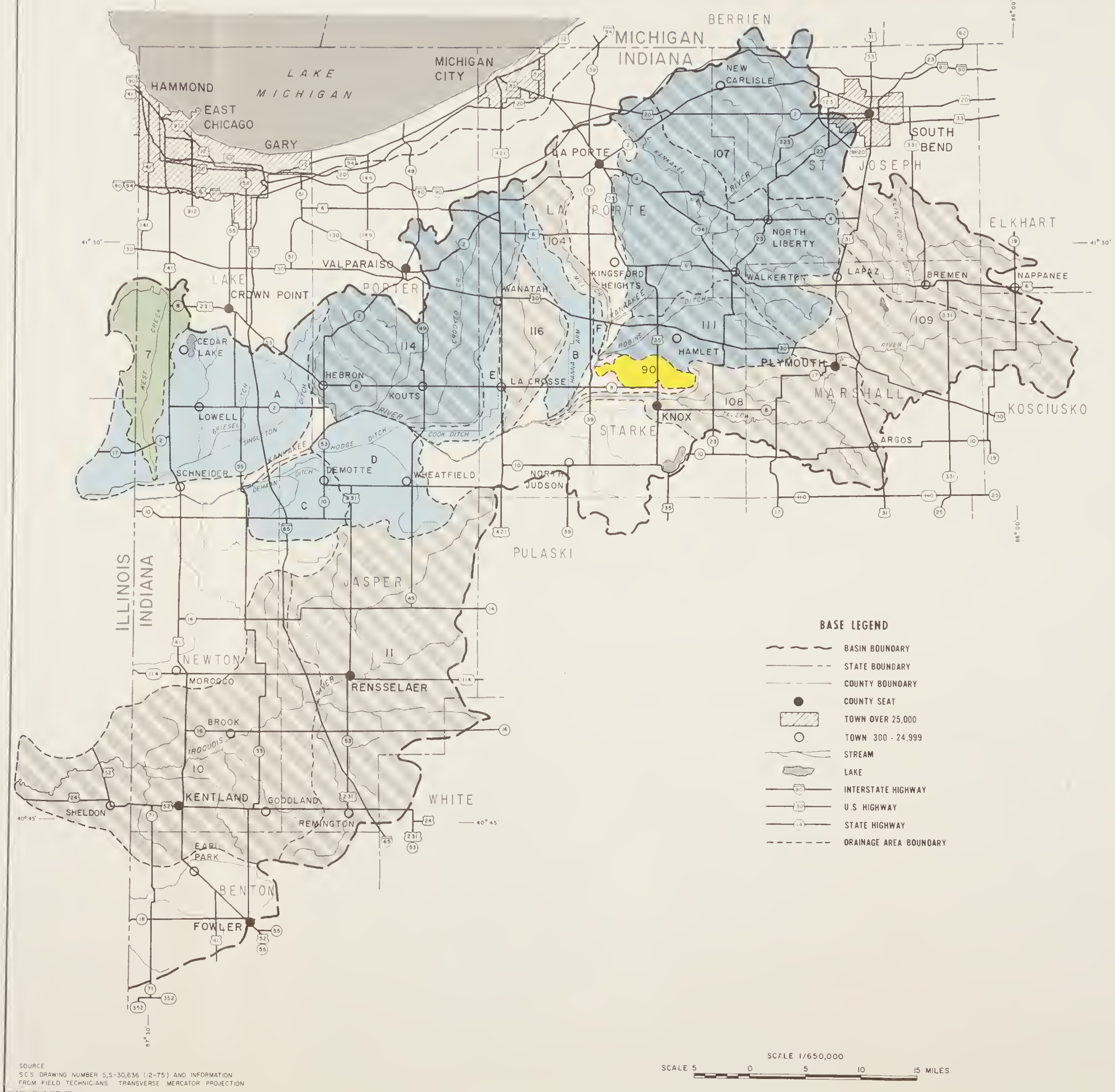
SCALE 5 0 5 10 15 MILES

TRANSVERSE MERCATOR PROJECTION

SOURCE
SCS DRAWING 5,S-30636 AND INFORMATION
FROM FIELD TECHNICIANS

REV 1-27-76

5,S-30628



WATERSHED KEY

AUTHORIZED FOR CONSTRUCTION (INACTIVE)
7 WEST CREEK

AUTHORIZED FOR PLANNING
90 BAILEY-COX-NEWTSON

APPLICATION RECEIVED (CURRENTLY FEASIBLE)
107 UPPER KANKAKEE RIVER
111 ROBBINS DITCH
114 PORTER COUNTY-KANKAKEE RIVER

APPLICATION RECEIVED (NOT CURRENTLY FEASIBLE)
10 LOWER IROQUOIS RIVER
11 UPPER IROQUOIS RIVER
104 MILL CREEK
108 LOWER YELLOW RIVER
109 UPPER YELLOW RIVER
116 MACHLER DITCH (PITNER)

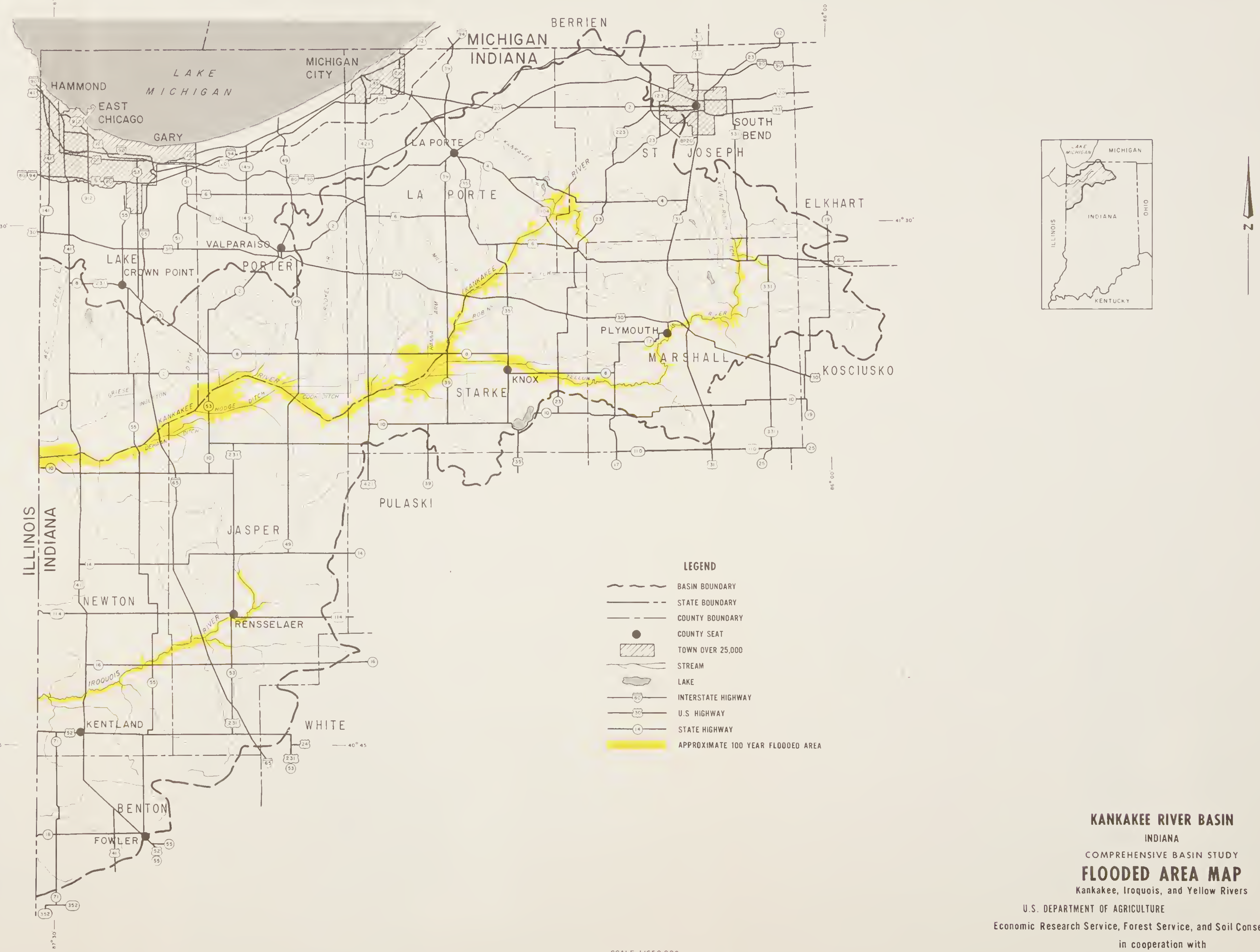
OTHER CURRENTLY FEASIBLE WATERSHEDS
A SINGLETON DITCH
B HANNA ARM
C DEHAAN DITCH
D HODGE DITCH (BARNARD)
E COOK DITCH
F MARQUARDT DITCH

KANKAKEE RIVER BASIN
INDIANA
COMPREHENSIVE BASIN STUDY

SMALL WATERSHED PROJECTS

U.S. DEPARTMENT OF AGRICULTURE JUNE 1976
Economic Research Service, Forest Service, and Soil Conservation Service
in cooperation with
STATE OF INDIANA – Department of Natural Resources
PLATE 16

12-12-75
5,S-35,474



SOURCE
SCS DRAWING NUMBER 5,S-30,636 (12-75) AND INFORMATION FROM FIELD TECHNICIANS TRANSVERSE MERCATOR PROJECTION

KANKAKEE RIVER BASIN

INDIANA

COMPREHENSIVE BASIN STUDY

FLOODED AREA MAP

Kankakee, Iroquois, and Yellow Rivers

U.S. DEPARTMENT OF AGRICULTURE JUNE 1976

Economic Research Service, Forest Service, and Soil Conservation Service

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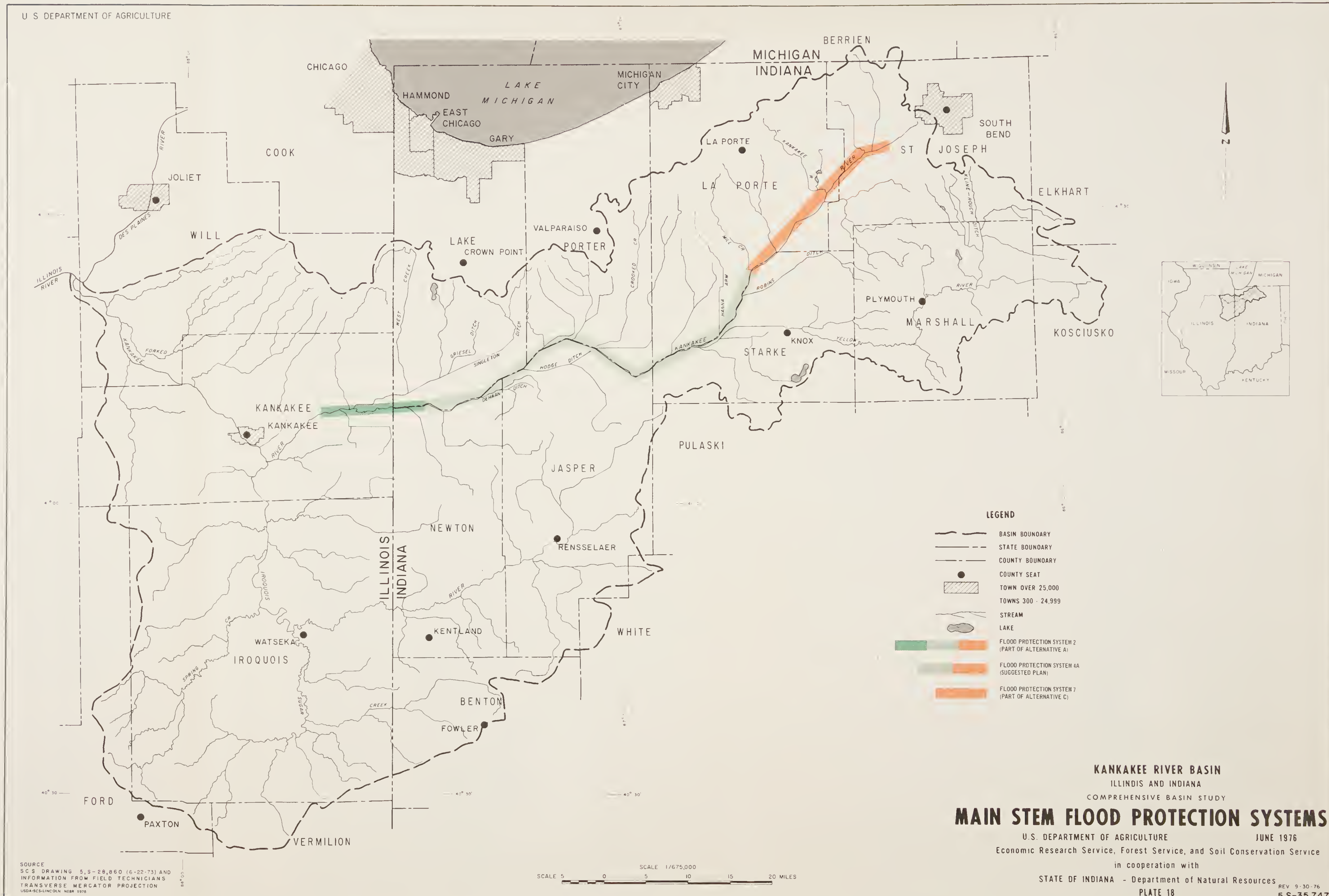
STATE OF INDIANA – Department of Natural Resources

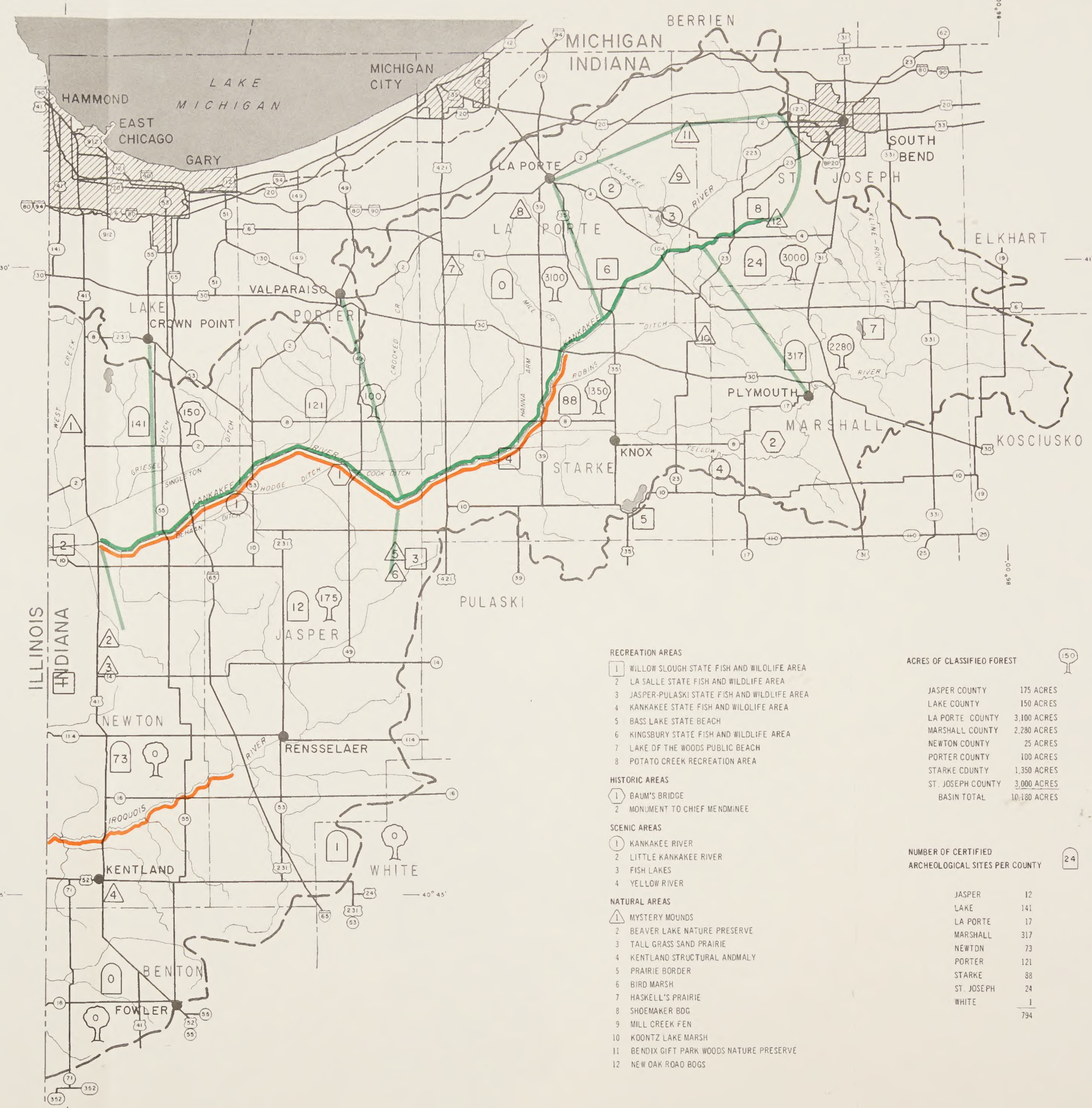
PLATE 17

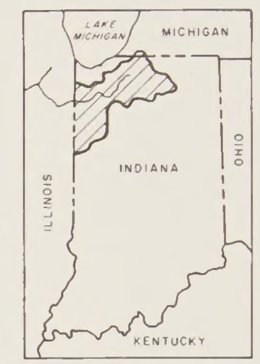
12-4-75
5,S-35,473



U S DEPARTMENT OF AGRICULTURE
MICHIGAN
INDIANA
BERRIEN
CHICAGO
LAKE MICHIGAN
HAMMOND
EAST CHICAGO
GARY
MICHIGAN CITY
SOUTH BEND
ST JOSEPH
LA PORTE
ELKHART
COOK
JOLIET
WILL
ILLINOIS RIVER
DES PLAINES
LAKE
CROWN POINT
VALPARAISO
PORTER
PLYMOUTH
MARSHALL
KOSCIUSKO
KNOX
STARKE
KANKAKEE
PULASKI
JASPER
NEWTON
RENSSELAER
ILLINOIS
INDIANA
KENTLAND
WHITE
WATSEKA
IROQUOIS
BENTON
FOWLER
FORD
PAXTON
VERMILION
LEGEND
BASIN BOUNDARY
STATE BOUNDARY
COUNTY BOUNDARY
COUNTY SEAT
TOWN OVER 25,000
TOWNS 300 - 24,999
STREAM
LAKE
FLOOD PROTECTION SYSTEM 2 (PART OF ALTERNATIVE A)
FLOOD PROTECTION SYSTEM 4A (SUGGESTED PLAN)
FLOOD PROTECTION SYSTEM 7 (PART OF ALTERNATIVE C)
SOURCE
SCS DRAWING 5,S-28,860 (6-22-73) AND INFORMATION FROM FIELD TECHNICIANS
TRANSVERSE MERCATOR PROJECTION
SCALE 1/675,000
SCALE 5 0 5 10 15 20 MILES
KANKAKEE RIVER BASIN
ILLINOIS AND INDIANA
COMPREHENSIVE BASIN STUDY
MAIN STEM FLOOD PROTECTION SYSTEMS
U.S. DEPARTMENT OF AGRICULTURE JUNE 1976
Economic Research Service, Forest Service, and Soil Conservation Service
in cooperation with
STATE OF INDIANA - Department of Natural Resources
PLATE 18
REV 9-30-76
5,S-35,747

U. S. DEPARTMENT OF AGRICULTURE





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RECREATION AREAS

1. WILLOW SLOUGH STATE FISH AND WILDLIFE AREA
2. LA SALLE STATE FISH AND WILDLIFE AREA
3. JASPER-PULASKI STATE FISH AND WILDLIFE AREA
4. KANKAKEE STATE FISH AND WILDLIFE AREA
5. BASS LAKE STATE BEACH
6. KINGSBURY STATE FISH AND WILDLIFE AREA
7. LAKE OF THE WOODS PUBLIC BEACH
8. POTATO CREEK RECREATION AREA

HISTORIC AREAS

1. BAUM'S BRIDGE
2. MONUMENT TO CHIEF MENOMINEE

SCENIC AREAS

1. KANKAKEE RIVER
2. LITTLE KANKAKEE RIVER
3. FISH LAKES
4. YELLOW RIVER

NATURAL AREAS

1. MYSTERY MOUNDS
2. BEAVER LAKE NATURE PRESERVE
3. TALL GRASS SAND PRAIRIE
4. KENTLAND STRUCTURAL ANOMALY
5. PRAIRIE BORDER
6. BIRD MARSH
7. HASKELL'S PRAIRIE
8. SHOEMAKER BOG
9. MILL CREEK FEN
10. KOONTZ LAKE MARSH
11. BENDIX GIFT PARK WOODS NATURE PRESERVE
12. NEW OAK ROAD BOGS

ACRES OF CLASSIFIED FOREST (150)

JASPER COUNTY	175 ACRES
LAKE COUNTY	150 ACRES
LA PORTE COUNTY	3,100 ACRES
MARSHALL COUNTY	2,280 ACRES
NEWTON COUNTY	25 ACRES
PORTER COUNTY	100 ACRES
STARKE COUNTY	1,350 ACRES
ST. JOSEPH COUNTY	3,000 ACRES
BASIN TOTAL	10,180 ACRES

NUMBER OF CERTIFIED ARCHEOLOGICAL SITES PER COUNTY (24)

JASPER	12
LAKE	141
LA PORTE	17
MARSHALL	317
NEWTON	73
PORTER	121
STARKE	88
ST. JOSEPH	24
WHITE	1
	794

LEGEND

- BASIN BOUNDARY
- STATE BOUNDARY
- COUNTY BOUNDARY
- COUNTY SEAT
- TOWN OVER 25,000
- STREAM
- LAKE
- INTERSTATE HIGHWAY
- U.S. HIGHWAY
- STATE HIGHWAY
- RECREATION AREA
- HISTORIC AREA
- SCENIC AREA
- NATURAL AREA
- HORSEBACK RIDING
- BICYCLING & HIKING TRAILS (SUGGESTED PLAN)
- ADDITIONAL BICYCLING & HIKING TRAILS (OTHER ALTERNATIVES)

SCALE 1/650,000

SCALE 5 0 5 10 15 MILES

SOURCE
SCS DRAWING 5,S-30,628 AND
INFORMATION FROM FIELD TECHNICIANS.
TRANSVERSE MERCATOR PROJECTION
USDA-SCS-LINCOLN, NEBR. 1976

KANKAKEE RIVER BASIN

INDIANA

COMPREHENSIVE BASIN STUDY

RECREATION TRAILS

U.S. DEPARTMENT OF AGRICULTURE JUNE 1976

Economic Research Service, Forest Service, and Soil Conservation Service

in cooperation with

STATE OF INDIANA – Department of Natural Resources

PLATE 19

6-7-76

5,P-35,745